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ARTHRITIS AND ARTHRALGIA IN CHILDHOOD

DIANA WASSERMAN

1977

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ARTHRITIS AND ARTHRALGIA IN CHILDHOOD

Diana Wasserman

1977

Submitted in partial fulfillment

of the

Requirements for the degree of Doctor of Medicine.

Yale University School of Medicine

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Introduction

One of the more perplexing problems a pediatrician faces is the evaluation of a child who complains of pain or swelling in one or more joints. Diseases of nearly every organ system may present with articular complaints; consequently, the differential diagnosis of a child with joint pain or joint swelling includes not only primary diseases of the joints, but also common and obscure disorders in which the articular symptoms are minor or rare manifestations of the central disease. Difficulty in assigning a diagnosis to each child arises because the possibilities are numerous, the etiologies of many syndromes remain obscure, and the clinical characteristics of each disease vary widely from patient to patient. The importance of careful evaluation lies in the ability to distinguish children with benign, self-limited disease from those with potentially life-threatening conditions.

One approach to the problem is to investigate each child who complains of joint pains with the assumption that he or she has a serious illness. Electrocardiograms could be run on all to rule out the carditis of acute rheumatic fever, each painful joint could be aspirated to culture for septic arthritis, every symptomatic limb could be x-rayed and scanned to search for osteomyelitis. Blood counts, x-rays, serologic studies, ocular examinations, viral and bacterial cultures on every patient could ultimately be justified. This would be not only impractical, but also inconsiderate of patient, laboratories and whomever is paying the medical expenses.

At the other extreme, it is often easy to dismiss seemingly mild complaints as "probably traumatic", "probably psychogenic", or "joint complaint, unknown etiology". A history of trauma may often be elicited and is frequently the cause of joint pain in children. However, trauma may be the precipitating rather than the etiologic factor, may be coincidental, or may have an obscure relationship to the presenting symptoms, and another etiology often needs to be sought. Similarly, emotional problems are not uncommon in childhood, and if "psychogenic" reasons for experiencing pain are looked for, they are readily available. This diagnosis should not be made before organic causes are satisfactorily ruled out.

Laboratory studies may be useful in evaluating children with joint pain or joint swelling, but determinations are rarely diagnostic. Decisions about therapy must often be made on the basis of clinical judgement.

The difficulties in approaching children with joint complaints will be simplified by defining categories of symptoms and diseases, by analyzing the usefulness of various laboratory determinations and by developing a stepwise routine for evaluating these patients.

The purpose of this study is to review the range of pediatric illnesses which may present with articular complaints and to indtoduce data which reflects one hospital's experience with the problem. Guidelines for evaluating children with joint pain and/or joint swelling will be discussed with reference to history taking, physical examination, laboratory tests, diagnoses and follow up. For a discussion of

therapies the reader is referred to references dealing with the specific diseases.

Methods:

This study is composed of a review of the records of all patients who presented to ambulatory and inpatient services of the Yale New Haven Hospital with a chief complaint of joint pain and/or swelling during the period from July 1, 1972 to June 30, 1976.

Selection of charts was from several sources. 1) The emergency room log, a record of all emergency room visits with notations of name, date, chief complaint and diagnosis was searched. Cases were chosen for review if the chief complaint included joint pain, joint swelling, or other joint difficulty, or if the diagnosis suggested joint disease. 2) Records of inpatient admissions and discharges were screened for cases of hospitalized children whose admission or discharge diagnoses included or suggested articular pathology. 3) The files of the pediatric rheumatology clinic were reviewed and a small number of patients who presented to the clinic within the described time period, without a previous diagnosis, were included in the study.

Omitted in the chart selection phase were cases where directly antecedent trauma was present. For example, if the chief complaint listed, "fell on elbow," and the diagnosis was "fractured humerus," the case was not included. Similarly, if the chief complaint was, "swollen ankle," and the diagnosis was "insect bite," the case was excluded. If however, the complaint was "hip pain," and the diagnosis was "muscle strain," the chart was pulled since the records gave no information as to whether there was

a history of directly antecedent trauma.

Four hundred thirty-one charts were selected for review. One hundred and eighty-two of these were excluded from the final study for one of several reasons. 1) The patient had no joint complaints. A case might have been chosen for review because the diagnosis suggested that the patient had joint symptoms, as in the example of acute rheumatic fever. If on review of the chart no joint symptoms were found, the case was omitted.

2) There was a history of trauma which could be invoked as the direct etiology of the symptoms. The case of a patient who fell on a nail, abraded her knee, and presented the next day with pain and infection over her patella, would be excluded because the injury was clearly the cause of the symptoms. However, a child who presented with a six hour history of knee pain and, when asked for a history of trauma, remembered a fall which occurred two days prior during a basketball game, would be included since the injury was not clearly the source of the knee pain.

3) Patients who had a diagnosis established before presenting to the hospital were excluded. This would include patients with long-standing juvenile rheumatoid arthritis who presented with exacerbation of symptoms.

Demographic material was obtained either from the emergency room intake form or from the histories recorded by interns on inpatient admissions. Race is recorded as "white", "black", or Hispanic.

Previous visits or admissions included in the hospital charts were reviewed for evidence of prior joint problems. Follow-up information was obtained from chart entries subsequent to the visit under review. If a patient was seen more than once for joint-related problems, the first visit which occurred during the four year time span of the study was studied.

Physical examination findings were taken from the initial visit, rather than from follow-up visits, although later examinations were noted under follow-up data. Fevers were recorded as the highest temperature either by history or at presentation. Joint x-rays and other laboratory test results were recorded based on the primary evaluation. If sequential studies were done, only the original values are included in the study analysis.

Diagnoses were recorded for outpatients according to the examining physician's evaluation. For inpatients the discharge diagnosis was used.

The Retrospective Method

Ideally clinical reserach should be done on a prospective basis with controls matched for age and sex, and a methodology which limits the extent of observer variation. A retrospective study suffers from inconsistencies in the collection and analysis of data, the criteria used for diagnosis, and the management of patients.

The source for a large proportion of case material in this review was the emergency room. In that setting the method of evaluation of each patient depends not only on the knowledge and experience of the intern or resident who performs the evaluation, but also on how "busy" the emergency room is, and on how much time the patient can be alloted. Even if a complete medical history and physical examination are completed, the written account of the evaluation is often abbreviated.

A prospective study would include a preset number of variables to be examined, and for every patient those determinations would be recorded. A retrospective study relies on whatever information is available. In this review only some of the patients had temperatures recorded, many had white blood counts measured, and while a few had no laboratory tests done, several had over forty analyses.

Follow up is an integral part of a prospective study. Follow up data for the population of patients in this study is often absent or based on subsequent hospital visits for unrelated problems. In a number of cases follow up was referred to private physicians.

While these limitations need to be recognized, they do not leave retrospective analysis without value and significance. The chart review is a method of study which reveals how patients are actually managed. A prospective study is usually done by someone with expertise in the given field. Retrospective chart review demonstrates the level of understanding and variation of management of a wide group of observers. This can become a part of, rather than a limitation of the review.

Prospective studies require many hours of planning, the recruitment of a patient population, and more time for adequate follow up; while a retrospective study can be accomplished in a relatively short period. This review includes patients seen in a four year span.

Data collected in any study must be viewed with regard to the limitations of the study. The purpose of this review was to survey the incidence of arthritis and arthralgia at one hospital, and to try to point out which methods of evaluating patients seem of most value. This is not to presume that our experience is the definitive study on the incidence and characteristics of the various causes of joint pain and/or swelling among children. Rather, it is meant as a point of departure for further investigations into the field.

Results

Two hundred fifty cases were included in the final data analysis. Diagnostic interpretations as well as elements of the medical histories, physical examinations, and laboratory test results were studied.

Demographic characteristics of the study population reflect the roles of Yale-New Haven Hospital as a source of primary care for a large number of city residents, and as secondary or tertiary referral center for the county and state. 67% of the patients lived in the immediate New Haven area, and another 12% in the New Haven suburbs. Four children were referred from out of state (Table 1-1). 45% had private physicians, and 7% received health care from area group health plans. Another 20% used the hospital pediatric ambulatory care facility, while 17% had no source of primary health care. 42% of the patients relied on welfare funds for the payment of medical expenses.

The majority of the patients, 71%, presented to the emergency room. 25% were referred to Yale-New Haven Hospital by private physicians or outside hospitals, and 3% were seen first in the pediatric rheumatology clinic. Ultimately 37% were admitted for evaluation or treatment and 63% were seen as outpatients.

Diagnoses were applied to only 72% of the patients. The remaining 28% were grouped under the category, "unknown etiology". Forty-eight separate diagnoses were invoked as the causes of joint pain and/or swelling, and are listed in Table 1-2. In order to facilitate a discussion of the results, the diagnoses were grouped as shown in Table 1-3.

1-1 Town of Residence

Town	Number	Percent (if ≥ 1%)
Total	227	100
New Haven	118	52
West Haven	27	12
East Haven	8	4
Hamden	4	2
North Haven	4	2
Woodmont	1	
Milford	4	2
Stratford	1	
Bridgeport	1	
Westport	1	
Danbury	1	
Brookfield	1	
Branford	8	4
Guilford	6	3
Madison	4	2
Clinton	4	2
Westbrook	1	
Old Saybrook	2	1
New London	2	1
Waterford	1	
Groton	2	1
Seymour	2	1
Ansonia	4	2
Northford	1	
Chesire	2	1
Yalesville	1	
Wallingford	4	2
Middletown	3	1
Moodus	1	
Killingworth	1	
Waterbury	3	1
Out of State	4	2

DIAGNOSES	NUMBER	PERCENT
Total	250	100.0
Unknown Etiology	69	27.6
Septic Arthritis (SA)	19	7.6
Traumatic	18	7.2
Juvenile Rheumatoid Arthritis (JRA)	14	5.6
Allergic Reaction	14	5.6
Transient Synovitis of the Hip (T.S.Hip)	14	5.6
Osgood Schlatter's Disease	10	4.0
Cellulitis	10	4.0
Osteomyelitis	9	3.6
Acute Rheumatic Fever (ARF)	8	3.2
Henoch-Schonlein Purpura (HSP)	6	2.4
"Viral-related"	5	2.0
Osteochondritis Dissecans	4	1.6
Muscular Pain	4	1.6
"Normal child"	4	1.6
Benign Bone lesions	2	0.8
Fractures	2	0.8
Pneumonia	2	0.8
Staphylococcemia	2	0.8
Salmonella Infection	2	0.8
Growing Pains	2	0.8
Psychogenic	2	0.8
Abscess	2	0.8
Septic Arthritis and Osteomyelitis	1	0.4
Dermatomyositis	1	0.4
Sjogren's Syndrome	1	0.4
Pneumococcemia	1	0.4
Meningococcemia	1	0.4
Streptococcal Infection	1	0.4
Inguinal Adenitis	1	0.4
Mumps Arthritis	1	0.4
Mycoplasma Arthritis	1	0.4
Slipped Capital Femoral Epiphysis	1	0.4
Legg-Perthes' Disease	1	0.4
Kohler's Disease	1	0.4
Subluxed Patella	1	0.4
Lax Ligament	1	0.4
Popliteal Cyst	1	0.4
Acute Lymphocytic Leukemia	1	0.4
Osteogenic Sarcoma	1	0.4
Vaso-occlusive Crisis	1	0.4
Child Abuse	1	0.4
Tenosynovitis	1	0.4
Erythema Nodosum	1	0.4
Prepatellar Bursitis	1	0.4
Subepidermal Inclusion Cyst	1	0.4
Foreign Body Reaction	1	0.4
Osteogenesis Imperfecta - ? etiology of pain	1	0.4
? Seizure Activity	1	0.4

DIAGNOSTIC CATEGORIES	NUMBER	PERCENT
Juvenile Rheumatoid Arthritis	14	5.6
Acute Rheumatic Fever	8	3.2
Allergic Reactions	14	5.6
Henoch-Schonlein Purpura	6	2.4
Septic Arthritis	20	7.6
Osteomyelitis	10	4.0
Cellulitis	10	4.0
Other Infections-Bacterial	10	4.0
Pneumococcemia		
Meningococcemia		
Staphylococcemia		
Salmonella infection		
Streptococcal infection		
Abscess		
Inguinal adenitis		
Other Infections-Non-Bacterial	9	3.6
"Viral related"		
Mumps arthritis		
Mycoplasma arthritis		
Pneumonia		
Transient Synovitis of the Hip	14	5.6
Psycho-social Problems	9	3.6
"Normal child"		
"Psychogenic"		
"Growing Pains"		
Child Abuse		
Traumatic	18	7.2
Orthopedic-Non-traumatic	28	11.2
Osgood - Schlatter's disease		
Kohler's disease		
Osteochondritis Dissecans		
Slipped Capital Femoral Epiphysis		
Legg-Perthes Disease		
Old Fractures		
Benign Bone Lesions		
Muscular Pain		
Popliteal Cyst		
Subluxed Patella		
Lax-Ligament		
Other	12	4.8
Dermatomyositis		
Sjogren's Syndrome		
Leukemia		
Osteogenic Sarcoma		
Vaso-occlusive crisis		
Tenosynovitis		
Erythema Nodosum		
Prepatella bursitis		
Subepidermal inclusion cyst		
Foreign body reaction		
Osteogenesis Imperfecta		
? Seizure Activity		
Unknown etiology: multiple (≥ 2 unrelated) joints	19	7.6
Unknown etiology: single (one or both-same) joint	50	20.1

Septic arthritis was the single diagnosis named most frequently. There were nineteen children with septic arthritis, nine with osteomyelitis, and one with both septic arthritis and osteomyelitis. Fourteen children (5.6%) had juvenile rheumatoid arthritis, and eight had acute rheumatic fever (3.2%). There were two malignancies in the population: one case of acute lymphocytic leukemia and one of osteogenic sarcoma.

Diseases listed under "infections-bacterial" include several cases of joint pain associated with bacteremias, several cases of Salmonella-related arthritis, a case of inguinal adenitis, two abcesses, and one case of joint pain attributed to a concurrent streptococcal infection. The classification "infections - non-bacterial" includes six viral associated syndromes, one case of mycoplasma arthritis, and two cases of pneumonia without proven bacterial etiology.

"Psychosocial" includes children diagnosed as "normal", or whose joint syndromes were classified as "psychogenic" or "growing-pains". This latter designation will be discussed in greater detail in a subsequent chapter. The one case of child abuse diagnosed in the study population is included in this, rather than the "traumatic", category.

"Orthopedic" includes those disorders, whose etiology is not clearly traumatic, which involve alterations in the normal structure and mechanical function of the bones, muscles, tendons, and ligamentous supports of the joints.

The malignancies, one case of dermatomyositis, one of Sjogren's syndrome, and eight other miscellaneous diagnoses are included in the

"other" category. Patients with joint complaints of unknown etiology were divided into those with multiple ($\geq$ 2 unrelated) joint involvement, and those with single (one or both of the same) joint involvement.

The ages of the patients in the study ranged from one month to eighteen years old. Table 1-4 and Figure 1-1 demonstrate the distribution of ages among the diagnostic categories. The entire population was quite evenly distributed over the 0-3 year, 4-7 year, 8-11 year, and 12-15 year age groups, as shown in Figure 1-1. The lack of patients in the 16-19 year group may be explained by their optional use of pediatric or adult medical facilities.

Several of the diseases were limited to specific age groups. Henoch-Schonlein Purpura was diagnosed in six children, all were less than eight years old. Transient synovitis of the hip was most common in children less than eight years old, and was not present in children from ten months to twelve years old, but was more common in the younger age groups. While this may represent a true age distribution for JRA in this area, it is not entirely characteristic of the illness (24). Acute rheumatic fever was not present in any children less than four years old.

Septic arthritis was most frequent in young children, but osteomyelitis was distributed fairly evenly over the age ranges.

AGES (YEARS)	NUMBER	MEAN	STANDARD DEVIATION
Total	250	8.2	± 4.6
JRA	14	5.6	± 3.7
ARF	8	10.6	± 4.0
Allergic	14	7.4	± 4.0
HSP	6	4.5	± 1.6
Septic Arthritis	20	4.4	± 3.8
Osteomyelitis	10	8.4	± 4.8
Cellulitis	10	6.5	± 4.0
Infections-Bacterial	10	10.1	± 3.7
Infections-Non-Bacterial	9	9.8	± 3.9
T.S. of Hip	14	5.5	± 2.5
Psycho-social	9	8.1	± 4.9
Traumatic	18	6.3	± 4.3
Orthopedic	28	11.0	± 4.3
Other	12	8.5	± 4.3
? Etiology-Multiple	19	10.4	± 4.7
? Etiology-Single	50	8.7	± 4.7

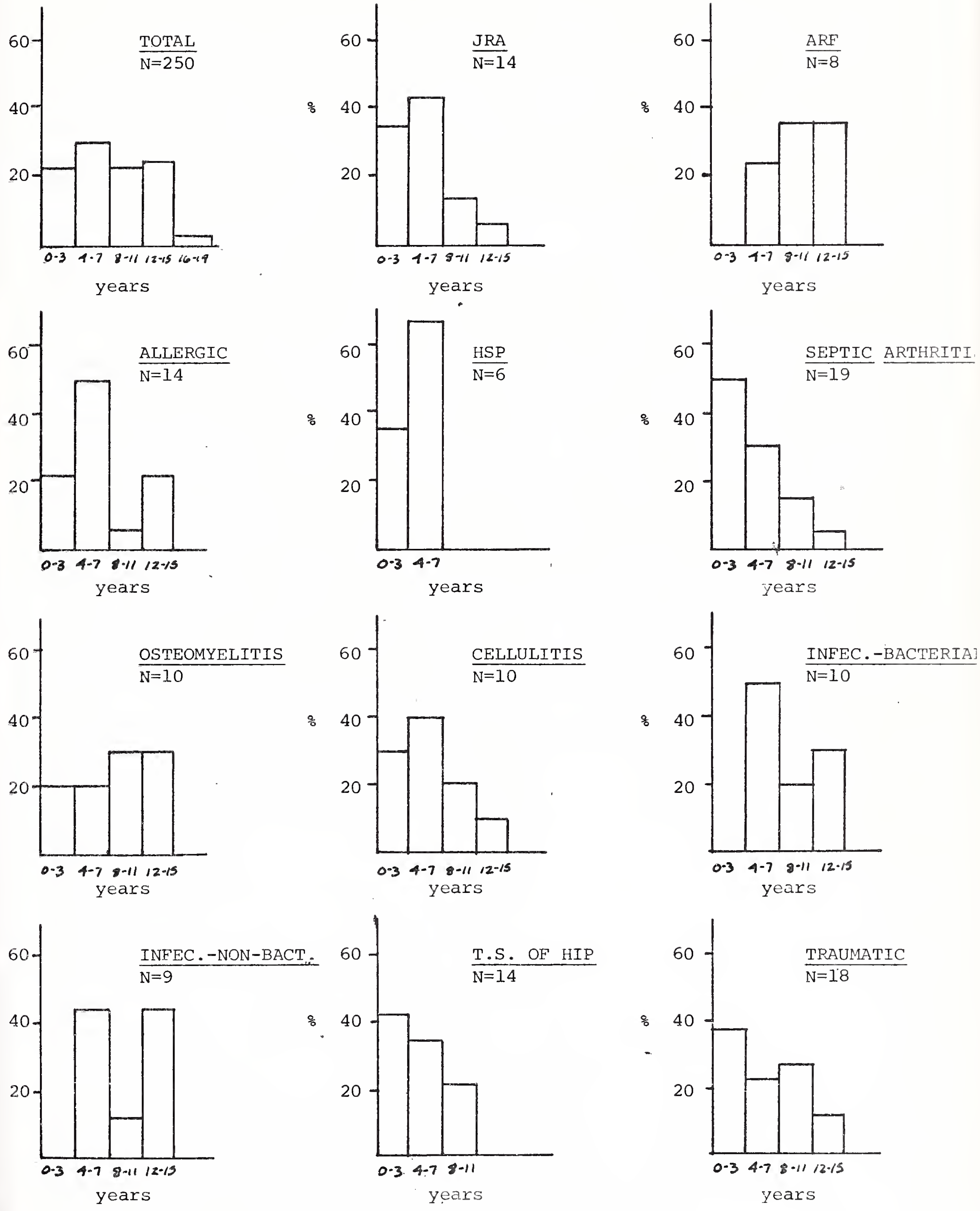

FIGURE 1-1: AGES

FIGURE 1-1: AGES
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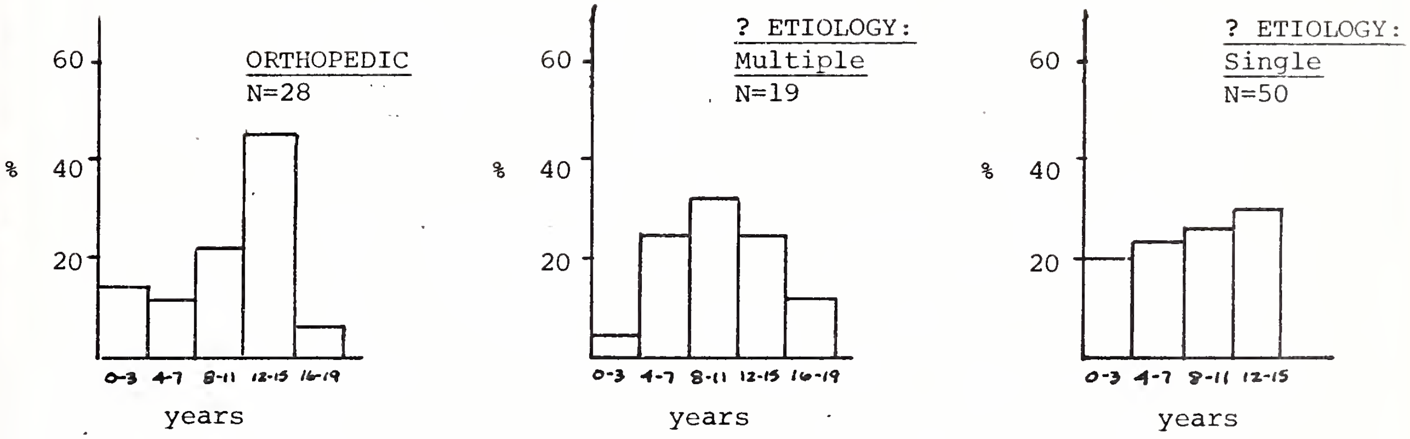


Allergic reactions were also more common in children less than eight years old, and they had a peak incidence in the four to seven age range.

Traumatic injuries were seen at every age, but other orthopedic ailments were most prevalent in the adolescent and pre-adolescent years.

According to the mean ages listed in table 1-4 juvenile rheumatoid arthritis, Henoch-Schonlein purpura, septic arthritis, and transient synovitis of the hip are usually diseases of young children, while acute rheumatic fever, bacterial infections and orthopedic problems are most common in older children. Because the sample size of these diagnostic categories are limited they should be seen as a reflection of our experience rather than of general disease incidence. In the discussion of the differential diagnosis of arthritis and arthralgia our results will be compared to larger series of patients.

The sexes of the patients are shown in table 1-5. There were one hundred forty-nine males (60%) and one hundred one females (40%) in the entire group, producing a male to female ratio of about 1.5:1. This slight male predominance was carried through most of the diagnostic categories with several exceptions. Acute rheumatic fever was diagnosed with equal frequency in boys and girls. Allergic reactions showed a female predominance of 1.8:1 ($P = 0.06$).

The male predominance was significantly exaggerated in transient synovitis of the hip with a ratio of 6:1 ($P = 0.05$).

The racial characteristics of the two hundred fifty children are shown in table 1-6. 52% of the total group were white, 40% were black

1-5

SEX

	NUMBER	MALE (PERCENT)	FEMALE (PERCENT)
Total	250	60	40
JRA	14	57	43
ARF	8	50	50
Allergic	14	36	64
HSP	6	67	33
Septic Arthritis	20	55	45
Osteomyelitis	10	60	40
Cellulitis	10	70	30
Infection - Bacterial	10	60	40
Infection - Non-bacterial	9	56	44
T.S. of hip	14	86	14
Psycho-social	9	67	33
Other	12	42	58
Orthopedic	28	71	29
Traumatic	18	61	39
? Etiology - multiple	19	58	42
? Etiology - single	50	56	44

RACE

	NUMBER	WHITE (%)	BLACK (%)	HISPANIC (%)
Total	250	52	40	8
JRA	14	79	14	7
ARF	8	50	25	25
Allergic	14	29	64	7
HSP	6	67	17	17
Septic Arthritis	20	60	30	10
Osteomyelitis	10	60	30	10
Cellulitis	10	40	60	
Infection - Bacterial	10	60	40	
Infection - Non-bacterial	9	67	22	11
T.S. of hip	14	72	14	14
Psycho-social	9	33	56	11
Other	12	50	33	17
Orthopedic	28	54	43	3
Traumatic	18	61	39	
? Etiology - Multiple	19	53	32	15
? Etiology - Single	50	38	58	4

and 8% were Hispanic. There is considerable variation in the racial composition of the diagnostic categories, but these results are difficult to interpret. The population which uses Yale-New Haven Hospital as a primary source of medical care includes a larger percentage of non-white than the population which uses private physicians.

Twelve of fourteen of the patients with juvenile rheumatoid arthritis were referred from private physicians or other hospitals, and therefore may not be representative of the racial characteristics of the general population. 79% of the patients with JRA in this study were white.

The increased ratio of black to white patients in the allergic category is less easily explained. Over twice as many black children had allergic disorders than did white children. Although with our limited number of patients this is not statistically significant ($P = 0.17$), it may represent a true increased incidence in black patients and deserves further investigation.

There was also an unexplained increase in the ratio of black to white children who had "single joint-unknown etiology" as their diagnosis ($P = 0.03$).

Table 1-7 demonstrates the seasonal variations among the patients presenting with different illness. Because the numbers in each category are so small it is hard to draw any conclusions from these results. The overall percentages are quite well distributed over the four seasons, perhaps showing a slightly increased incidence of complaints in the spring. This increase was of significant proportion for the "traumatic" category ($P = 0.005$).

SEASONAL VARIATION

	WINTER (12,1,2)	SPRING (3,4,5)	SUMMER (6,7,8)	FALL (9,10,11)
Total	24%	31%	24%	21%
JRA	14%	21%	21%	44%
ARF	38%	12%	25%	25%
Allergic	29%	50%	7%	14%
HSP	17%	33%	17%	33%
Septic Arthritis	25%	35%	30%	10%
Osteomyelitis	10%	30%	50%	10%
Cellulitis	40%	20%	10%	30%
Infection - Bacterial	10%	30%	20%	40%
Infection - Non-bacterial	44%	11%	22%	22%
T.S. Hip	36%	21%	21%	21%
Orthopedic	29%	32%	29%	11%
Traumatic	11%	61%	17%	11%
Psycho-social	33%	44%	11%	11%
Other	17%	58%	17%	8%
? Etiology - Multiple	21%	11%	37%	32%
? Etiology - Single	22%	26%	28%	24%

Patients who presented with complaints of pain and/or swelling in one or more joints were included in this study. Tables 1-8 and 1-9 show the percentages of patients with each symptom. Two hundred and one children (81%) complained of joint pain, while only seventy-five (30%) complained of swelling. Pain was a common complaint in nearly all groups. Every child with acute rheumatic fever, Henoch-Schonlein purpura, and transient synovitis of the hip complained of pain. The presence of joint pain as a presenting complaint was more variable in children with cellulitis, juvenile rheumatoid arthritis and allergic disorders.

Although pain was a presenting symptom in most children, those patients with cellulitis or allergic reactions complained of swelling more frequently than they complained of pain. Swelling was also a common symptom in children with Henoch-Schonlein purpura, "infections-bacterial", juvenile rheumatoid arthritis, and acute rheumatic fever. Patients with transient synovitis of the hip, or those grouped under "psycho-social problems" never complained of swelling.

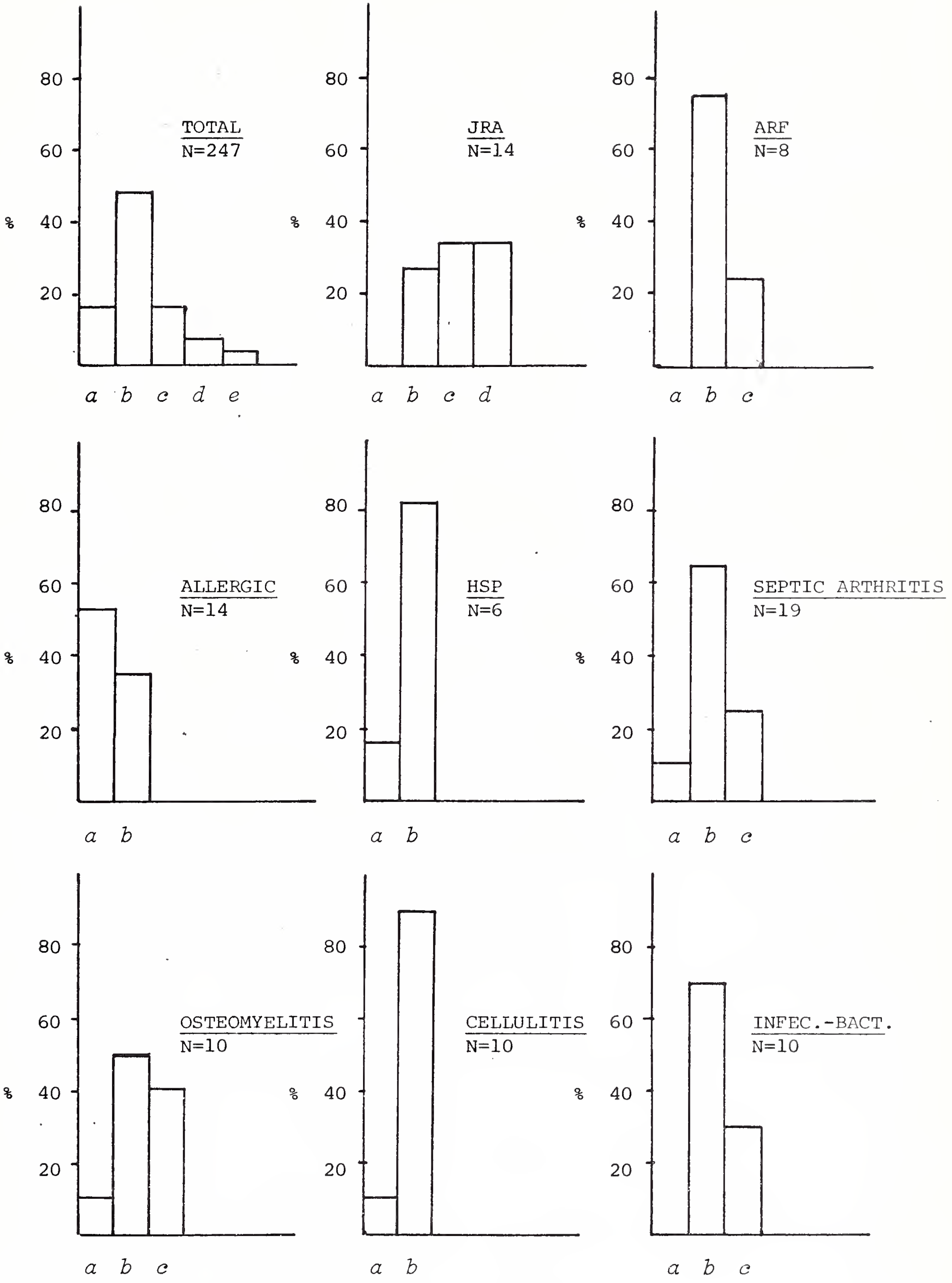
The duration of joint symptoms ranged from less than one hour to over two years. Figure 1-2 and table 1-10 demonstrate the differences in the duration of symptoms between the diagnostic categories. Patients with allergic reactions, Henoch-Schonlein purpura and cellulitis all presented with a history of joint symptoms of only a few hours' to days' duration. Children with non-bacterial infections all had symptoms which began one to six days before presentation.

PRESENTING COMPLAINTS: PAIN	NUMBER	PERCENT
Total	202	81
ARF	8	100
HSP	6	100
Transient Synovitis of Hip	14	100
? Etiology-Single	45	90
Septic Arthritis	18	90
Infection-Non-Bacterial	8	89
Orthopedic	24	86
Other	7	83
Osteomyelitis	8	80
? Etiology-Multiple	17	79
Traumatic	14	78
Psycho-social	7	78
Cellulitis	6	60
Infection-Bacterial	6	60
JRA	8	57
Allergic	6	43

PRESENTING COMPLAINTS: SWELLING	NUMBER	PERCENT
TOTAL	75	30
Cellulitis	9	90
HSP	5	83
Allergic	9	64
Infection-Bacterial	6	60
JRA	7	50
ARF	4	50
Septic Arthritis	7	35
Other	4	33
Osteomyelitis	3	30
Traumatic	4	22
? Etiology-Multiple	4	21
Orthopedic	5	18
? Etiology-Single	7	14
Infection-Non-Bacterial	1	11
Transient Synovitis of Hip	-	-
Psycho-social	-	-

1-10 Duration of Joint Symptoms (days)

	Number	Mean	Standard Deviation
Allergic	13	1.1	± 1.1
HSP	6	1.3	± 1.1
Cellulitis	10	1.4	± 0.9
Infections-Non-bacterial	9	1.4	± 0.9
T.S. of hip	14	1.7	± 2.3
Traumatic	18	1.9	± 2.2
Septic Arthritis	20	4.1	± 4.5
Infections-Bacterial	10	4.5	± 4.1
Osteomyelitis	10	5.7	± 4.8
ARF	8	5.8	± 4.7
? Etiology-Multiple	19	24.1	± 47.7
Other	12	24.7	± 32.3
JRA	14	28.2	± 28.8
? Etiology-Single	50	24.6	± 100.1
Orthopedic	28	91.6	± 175.2
Psycho-social	9	183.8	± 377.1



a = 0-23 hours
b = 1-6 days
c = 7-30 days
d = 1-5 months
e = 6 or more months

FIGURE 1-2: DURATION OF JOINT SYMPTOMS

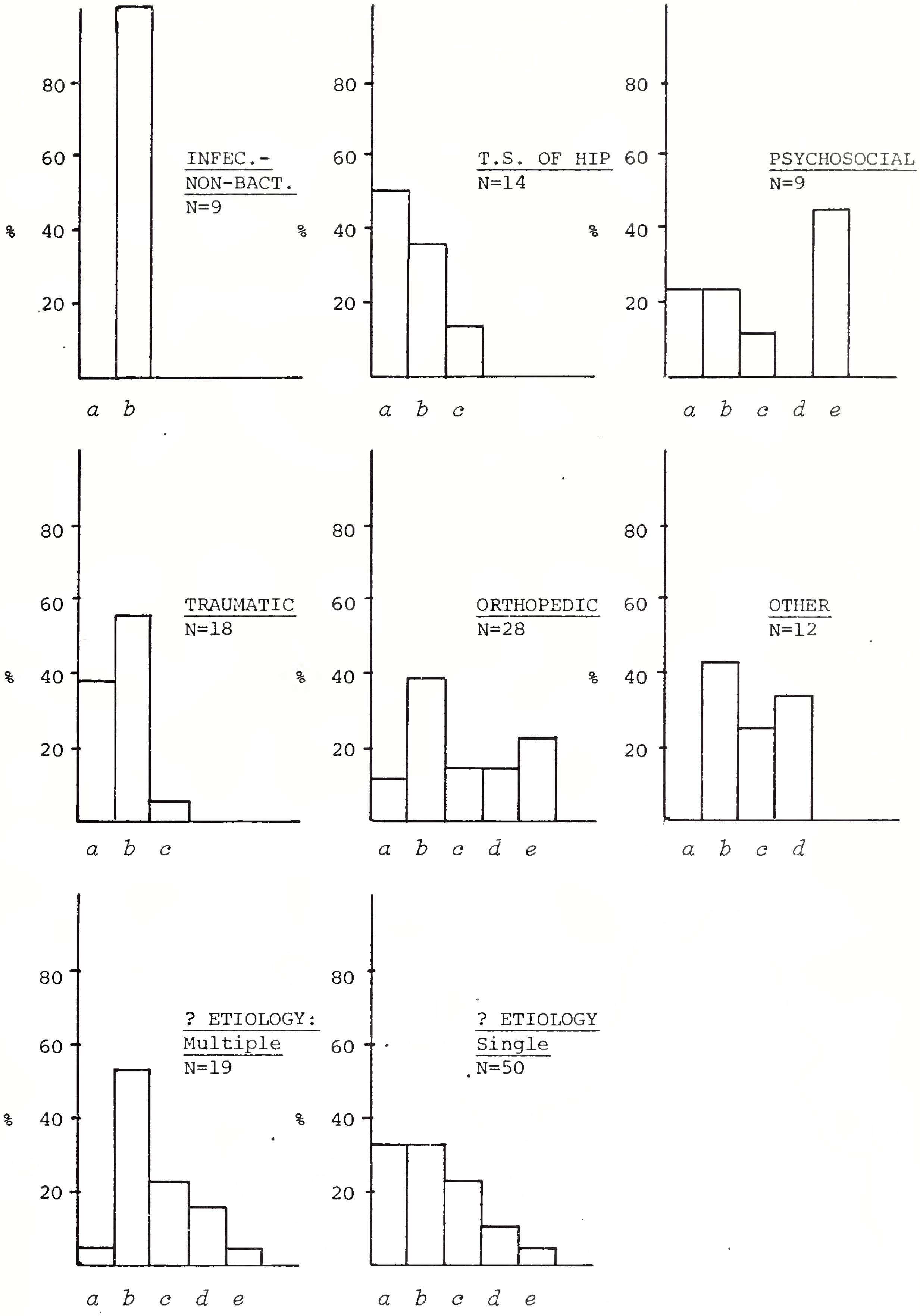


FIGURE 1-2: DURATION OF JOINT SYMPTOMS
(Page 2)

The mean duration of joint pain and/or swelling in children who had transient synovitis of the hip or traumatic disorders was less than two days. However in both categories there were patients whose symptoms had been present for up to eight days.

The duration of joint symptoms in patients with acute rheumatic fever, septic arthritis, osteomyelitis, and "other bacterial infections" ranged from several hours to about two weeks and was never greater than four weeks. The mean durations for these categories were four or five days.

Juvenile rheumatoid arthritis was never diagnosed in children whose onset of symptoms was less than one day or greater than five months before the time of presentation. The fourteen cases are distributed quite evenly over the 1-6 day, 7-30 day, and 1-5 month divisions shown in Figure 1-2.

Orthopedic (non-traumatic) and psychosocial categories show wide variance in the duration of joint symptoms. The mean durations were 91.6 and 183.8 days respectively, but in some cases onset of symptoms was only several hours before presentation. Nevertheless, 77% of patients with symptoms of greater or equal to six months' duration belonged to "orthopedic" or "psychosocial" categories.

Fifty-nine children gave a history of trauma, 24% of the entire group. In only 17% of these patients was trauma invoked as the direct etiology of the joint symptoms. Patients with cellulitis, septic arthritis and osteomyelitis frequently had a history of injury, while those with juvenile rheumatoid arthritis, acute rheumatic fever, allergic disorders, and Henoch-Schonlein purpura never reported trauma.

Table 1-11 shows the incidence of a history of trauma in each of the diagnostic categories. Of note is the fact that only 61% of those children who were diagnosed as having traumatically induced symptoms actually gave a history of trauma.

30% of the patients gave a history of illness concurrent with or within the month prior to the onset of joint symptoms. Antecedent illness was very frequent in patients with acute rheumatic fever, Henoch-Schonlein purpura, and allergic disorders, as shown in Table 1-12. None of the patients diagnosed as having juvenile rheumatoid arthritis gave a history of illness. Many of these children did have a history of fevers, however, and a concurrent illness may have been obscured.

The incidence of fever greater than or equal to 38° centigrade is shown in Table 1-13. The overall incidence was 36%, but there was wide variation among the diagnostic categories. Patients with septic arthritis invariably had fevers. 88% of those with juvenile rheumatoid arthritis, 80% with cellulitis, 75% with acute rheumatic fever, and 70% with osteomyelitis also had temperatures $\geq$ 38°. Only one patient with transient synovitis of the hip had a significant fever. Fevers were uncommon as well in patients with psycho-social, orthopedic and traumatic causes of joint symptoms.

Forty-three children (17%) had rashes at the time of presentation (Table 1-14). Allergic reactions and Henoch-Schonlein purpura were most frequently accompanied by skin changes. 57% of patients with juvenile rheumatoid arthritis had rashes, although the presence of a rash was seen primarily in one subgroup of the disease, as will be

1-11 Trauma

	Number	Percent	Percent of those with trauma
Total	59	24	100
Cellulitis	7	70	12
Traumatic	11	61	17
Osteomyelitis	5	50	8
Orthopedic	11	39	17
Septic Arthritis	7	35	12
Infections-Bact.	3	30	5
Other	3	25	5
T.S. hip	2	14	3
? Etiology-Single	7	14	12
? Etiology-Multiple	2	11	3
Infections-Non.-B	1	11	2
JRA	0		
ARF	0		
Allergic	0		
HSP	0		
Psycho-social	0		

ANTECEDENT ILLNESS	NUMBER	PERCENT
Total	74	30
ARF	7	88
Infections-Non-Bacterial	7	78
HSP	4	67
Allergic	8	57
? Etiology-Multiple	8	42
Septic Arthritis	7	35
Psycho-social	3	33
Osteomyelitis	3	30
Infections-Bacterial	3	30
? Etiology-Single	12	24
Transient Synovitis of hip	3	21
Traumatic	3	17
Other	2	17
Orthopedic	3	11
Cellulitis	1	10
JRA	0	-

FEVER ≥ 38° C.	NUMBER	PERCENT
Total	91	36
Septic Arthritis	20	100
JRA	12	88
Cellulitis	8	80
ARF	6	75
Osteomyelitis	7	70
Infections-Bacterial	7	70
Infections-Non-Bacterial	6	56
HSP	3	50
? Etiology-Multiple	6	32
Allergic	4	29
Other	3	25
Transient Synovitis of Hip	1	14
? Etiology-Single	6	12
Psycho-social	1	11
Orthopedic	1	4
Traumatic	0	-

RASH	NUMBER	PERCENT
Total	43	17
HSP	6	100
Allergic	12	86
JRA	8	57
? Etiology-Multiple	5	26
ARF	2	25
Infections-Non-Bacterial	2	22
Other	2	17
Septic Arthritis	3	15
? Etiology-Single	3	6
Osteomyelitis	0	-
Cellulitis	0	-
Infection-Bacterial	0	-
Transient Synovitis of Hip	0	-
Psycho-social	0	-
Orthopedic	0	-
Traumatic	0	-

discussed later. Rashes were not seen in children with osteomyelitis, cellulitis, transient synovitis of the hip, orthopedic or traumatic problems.

Joint involvement is summarized in Table 1-15. The knee was the most common site of joint complaints, 53%of the cases reviewed listed the knee or knees as one source of symptoms. The other large joints- ankles, hips, wrists, elbows, and shoulders- were mentioned more frequently than the small joints of the hands and feet. In septic arthritis, osteomyelitis and cellulitis the hands, feet, fingers, and toes were spared entirely. The neck was a site of pain in juvenile rheumatoid arthritis, acute rheumatic fever, and in one child with muscle spasm. Back and temporomandibular joint were uncommon focuses of complaints.

The ankle was affected with an equal or greater frequency than the knee in patients with Henoch-Schonlein purpura or allergic reactions. It was an uncommon site of symptoms in the non-traumatic "orthopedic" disorders.

The hip was a source of complaints in 20% of patients, and over one quarter of these were diagnosed as having "transient synovitis of the hip". Patients with allergic disorders or Henoch-Schonlein purpura did not complain of hip joint discomfort.

The joint examination was the portion of this study most influenced by observer variation. Some physicians distinguished between joint swelling, periarticular swelling, and joint effusions, while other reported any increase in joint size as swelling. The results recorded below are indicative of positive findings. It is unknown how completely each joint exam was performed.

1-15 JOINT INVOLVEMENT (PERCENTS)

	KNEE	ANKLE	HIP	WRIST	ELBOW	SHOULDER	HAND	FINGERS	FOOT	TOES	NECK	BACK	TMJ
Total	53	26	20	10	8	7	6	5	4	2	2	1	-
JRA	64	57	14	50	-	14	36	21	7	7	21	7	7
ARF	75	63	38	-	-	13	-	13	-	25	13	-	-
Allergic	57	57	-	14	7	-	21	36	29	-	-	-	-
HSP	33	50	-	17	-	-	33	-	33	-	-	17	-
Septic Arthritis	50	25	35	5	-	5	-	-	-	-	-	-	-
Osteomyelitis	60	20	20	-	-	10	-	-	-	-	-	-	-
Cellulitis	50	30	-	-	10	10	-	-	-	-	-	-	-
Inf. - Bact.	40	10	40	20	20	-	-	-	10	-	-	-	-
Inf - Non-Bact.	44	33	11	33	11	22	11	11	-	-	-	-	-
T.S. hip	-	-	100	-	-	-	-	-	-	-	-	-	-
Orthopedic	64	4	18	-	7	-	-	-	4	-	4	4	-
Traumatic	39	17	6	11	17	6	-	6	-	6	-	-	-
Other	33	25	17	17	8	8	8	17	-	-	8	-	-
? Etiology - M	74	63	16	32	42	37	11	11	5	-	-	-	-
? Etiology - S	60	12	12	-	2	4	-	2	2	-	-	-	-

The absence of any positive findings was recorded as a "negative examination" (Table 1-16). Two thirds of the patients with negative joint examinations belonged to "psycho-social", "bacterial infection", or "unknown etiology" categories. Children in the former two groups had negative joint examinations in a majority of cases. Patients with septic arthritis, osteomyelitis, cellulitis, and transient synovitis of the hip never had negative examinations.

Joint tenderness was recorded to be present in 49% of cases studied (Table 1-17). Tenderness was a common finding in children with osteomyelitis (80%) and septic arthritis (75%), a more variable sign in those with acute rheumatic fever (50%), juvenile rheumatic arthritis (36%), and allergic disorders (57%), and an uncommon finding in those with non-bacterial infections (22%) or in the "psycho-social" group (11%).

In some cases tenderness was not elicited when the affected joint was at rest, but was present when the joint was moved. Pain with joint motion was present in 30% of children, and in those with transient synovitis of the hip, cellulitis, and "other bacterial infections" was a more common finding than pain at rest (Table 1-17).

Joint swelling was noted in 99 (39%) cases. Table 1-18 shows the frequency of this finding in each diagnostic category. In no condition was joint swelling invariably found, but it was a common sign in those with cellulitis, Henoch-Schonlein purpura, septic arthritis, osteomyelitis, juvenile rheumatoid arthritis or allergic reactions.

NEGATIVE EXAM	NUMBER	PERCENT
Total	46	18
Psycho-social	7	78
Infections-Non-Bacterial	5	56
ARF	3	38
? Etiology-Single	14	28
? Etiology-Multiple	5	26
JRA	3	21
Other	2	17
HSP	1	17
Allergic	2	14
Infections-Bacterial	1	10
Orthopedic	2	7
Traumatic	1	6
Septic Arthritis	0	-
Osteomyelitis	0	-
Cellulitis	0	-
Transient Synovitis of Hip	0	-

1-17

	Joint Tenderness		Pain with Motion	
	Number	Percent	Number	Percent
Total	123	49	76	30
Osteomyelitis	8	80	8	80
Septic Arthritis	15	75	8	40
H.S.P.	4	67	0	-
? Etiology-Multiple	11	58	2	11
Allergic	8	57	3	21
Orthopedic	16	57	6	21
ARF	4	50	3	38
Traumatic	9	50	7	39
? Etiology-Single	24	48	14	28
T.S. of hip	6	43	11	79
JRA	5	36	3	21
Other	4	33	2	17
Cellulitis	3	30	4	40
Infection-Bact.	3	30	4	40
Infection-Non-B	2	22	0	-
Psycho-social	1	11	1	11

Effusions were recorded as being present in only 7% of patients (Table 1-18). As mentioned above, this may be in part a reflection of deficiencies in the written accounts of joint examinations. Since twenty-one children had joint aspirations performed, probably at least that number had joint effusions.

The other aspects of the joint examinations are summarized in Table 1-19. Limitations of normal joint range of motion were found in 19% of patients. Decreased range of motion was present in 42% of children with septic arthritis, in 29% of children with juvenile rheumatoid arthritis, and in 25% of those with acute rheumatic fever or orthopedic disorders. It was not found in children with Henoch-Schonlein purpura.

Heat was a common finding when osteomyelitis (60%), septic arthritis (50%), or cellulitis (70%) was present. Joint erythema, however, was noted in only 16% of children with septic arthritis and 20% of those with osteomyelitis, but was present in 80% of children with cellulitis. Erythema was not present in children with orthopedic or traumatic disorders.

Laboratory tests were performed in most of the children as part of their diagnostic evaluation. Some children had as many as forty different laboratory analyses done, while others had only a blood count or joint x-ray. Only the results of those tests which were performed in a significant number of cases, or which were particularly applicable to the evaluation of joint disorders will be discussed.

One hundred eighty-six children (74%) had hemoglobin levels measured. The mean level was 12.1 grams, and the range of values was

	Joint Swelling		Effusion	
	Number	Percent	Number	Percent
Total	100	40	18	7
Cellulitis	8	80	2	20
H.S.P.	4	67	1	17
Septic Arthritis	13	65	3	15
Osteomyelitis	6	60	0	-
JRA	8	57	0	-
Allergic	7	50	0	-
Other	5	42	0	-
? Etiology-Multiple	8	42	1	5
Traumatic	7	39	4	22
ARF	3	38	1	13
Orthopedic	8	29	2	7
Infection-Bact.	2	20	2	20
? Etiology-Single	6	12	0	-
Infection-Non-B	1	11	2	22
T.S. of the hip	0	-	0	-
Psycho-social	0	-	0	-

	Heat	Erythema	Decreased Range of Motion
Total	22%	12%	19%
JRA	21%	7%	29%
ARF	38%	25%	25%
Allergic	13%	7%	7%
HSP	33%	17%	-
Septic Arthritis	50%	16%	42%
Osteomyelitis	60%	20%	20%
Cellulitis	70%	80%	20%
Infections-Bact.	10%	10%	10%
Infections-Non-B	22%	-	22%
T.S. of the hip	-	-	21%
Other	25%	33%	17%
Psycho-social	-	-	-
Orthopedic	4%	-	25%
Traumatic	28%	-	6%
? Etiology-Multiple	26%	21%	16%
? Etiology-Single	12%	6%	20%

from 7.4 to 16.8 grams. Thirteen children had levels less than 10 grams of hemoglobin. 62% of children with that degree of anemia had either septic arthritis or juvenile rheumatoid arthritis.

Table 1-20 shows the ranges and mean hemoglobin values for the separate diagnoses. Patients with juvenile rheumatoid arthritis and septic arthritis had the lowest mean hemoglobin levels. The other categories show little variation from the overall mean of 12.1 grams. 46% of children with hemoglobin levels less than 10 grams were under thirteen months of age.

White blood counts were done on 74% of patients (Table 1-21). Patients with juvenile rheumatoid arthritis had the highest mean white cell count: 14,700 WBC/mm^3, and a range of 5,200 to 28,200 WBC/mm^3. Figure 1-3 shows the distribution of white counts for each diagnostic category. Although 38% of patients with JRA, and 30% of those with septic arthritis had counts equal to or greater than 15,000 WBC/mm^3, a significant number of both groups had normal derminations. Patients in the "bacterial infection" category were the only others with values greater than 20,000 WBC/mm^3.

White blood counts of children with acute rheumatic fever, transient synovitis of the hip, orthopedic, disorders and in the unknown etiology-multiple joint category, were all less than 15,000 WBC/mm^3. One patient with an allergic reaction had a value of 18,000, but it was not noted whether this was a pre- or post-epinephrine sample.

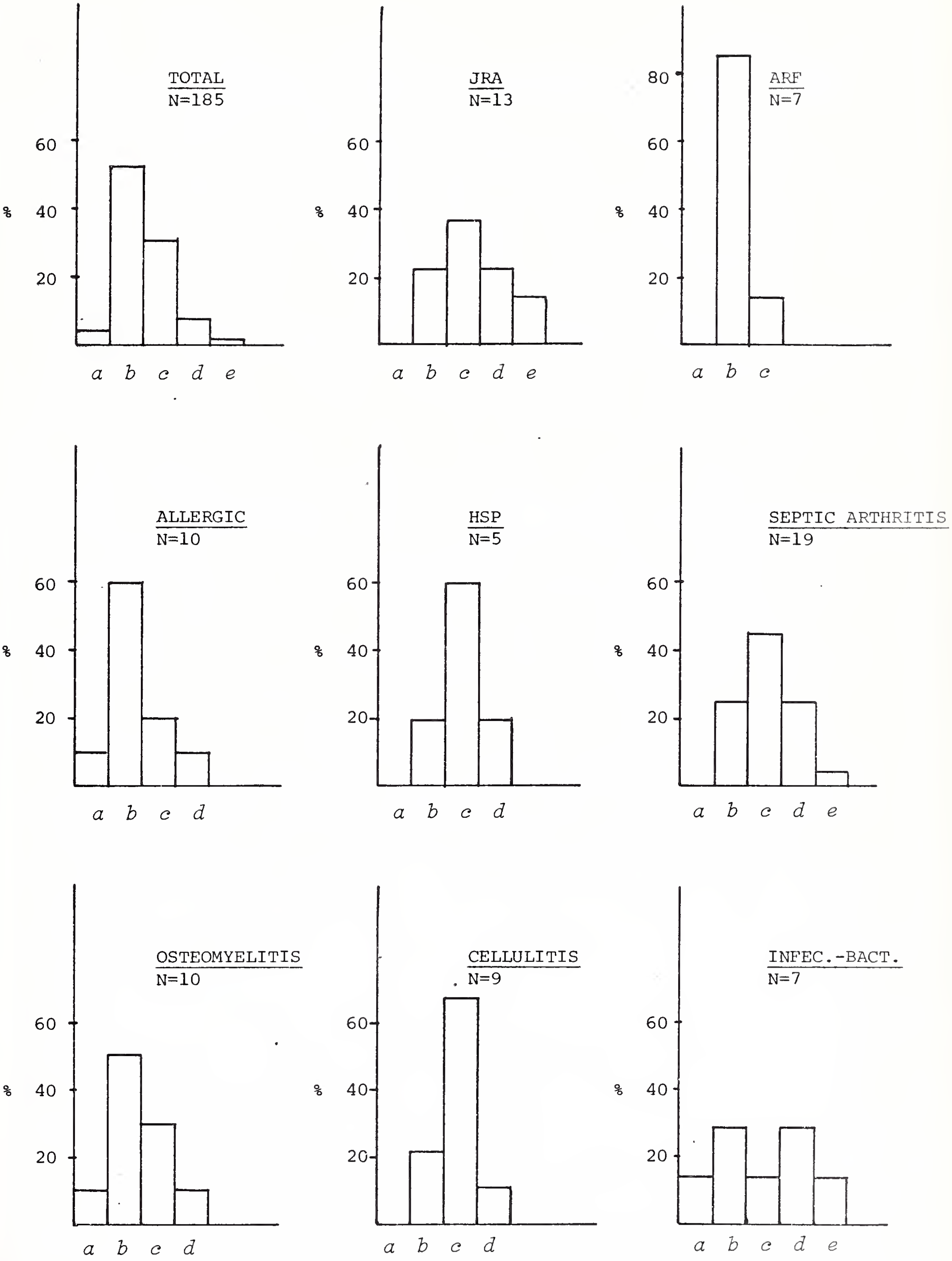
Erythrocyte sedimentation rates (ESR) showed more variation among the various diagnostic categories than did white blood counts. As

HEMOGLOBIN (GRAMS)

	NUMBER	MEAN	STANDARD DEVIATION	LOW	HIGH
Total	186	12.1	± 1.4	7.4	16.8
JRA	14	10.7	± 1.7	7.4	13.7
ARF	7	12.2	± 0.9	10.9	13.1
Allergic	11	12.2	± 1.0	10.9	13.9
HSP	5	12.4	± 0.4	11.8	13.0
Septic Arthritis	17	11.0	± 1.4	7.9	12.8
Osteomyelitis	10	12.1	± 2.1	9.2	15.9
Cellulitis	10	11.8	± 1.2	9.7	13.7
Infection - Bacterial	7	12.5	± 1.0	11.0	14.0
Infection - Non-bacterial	2	12.0	± 0.1	12.0	12.1
T.S. of Hip	12	12.7	± 1.1	11.1	14.5
Other	10	12.5	± 1.1	10.2	14.2
Psycho-social	3	12.0	± 0.9	11.0	12.6
Orthopedic	13	12.6	± 1.4	10.8	15.5
Traumatic	15	12.7	± 1.3	10.6	15.5
? Etiology - Multiple	17	12.5	± 1.0	10.4	14.0
? Etiology - Single	34	12.3	± 1.3	9.8	16.8

1-21 White Blood Count (WBC/mm^3)

	Number	Mean	Standard Deviation
JRA	13	14,700	± 6,900
Infection-Non-B	2	13,000	± 400
Infection-Bact.	7	12,900	± 6,800
H.S.P.	5	12,400	± 3,500
Septic Arthritis	20	12,300	± 3,900
Cellulitis	9	11,300	± 3,800
ARF	7	10,500	± 2,800
T.S. of hip	12	10,500	± 2,500
Psycho-social	3	9,800	± 6,100
Osteomyelitis	10	9,400	± 4,100
Allergic	10	9,300	± 3,800
? Etiology-Multiple	17	8,500	± 2,800
Traumatic	16	8,400	± 2,600
? Etiology-Single	33	8,400	± 2,800
Orthopedic	13	8,000	± 2,500
Other	10	7,600	± 2,000
Total	186	10,000	± 3,900



a = less than 5,000
b = 5-9,000
c = 10-14,000
d = 15-19,000
e = 20,000 or greater

FIGURE 1-3: WHITE BLOOD COUNT (WBC/mm^3)

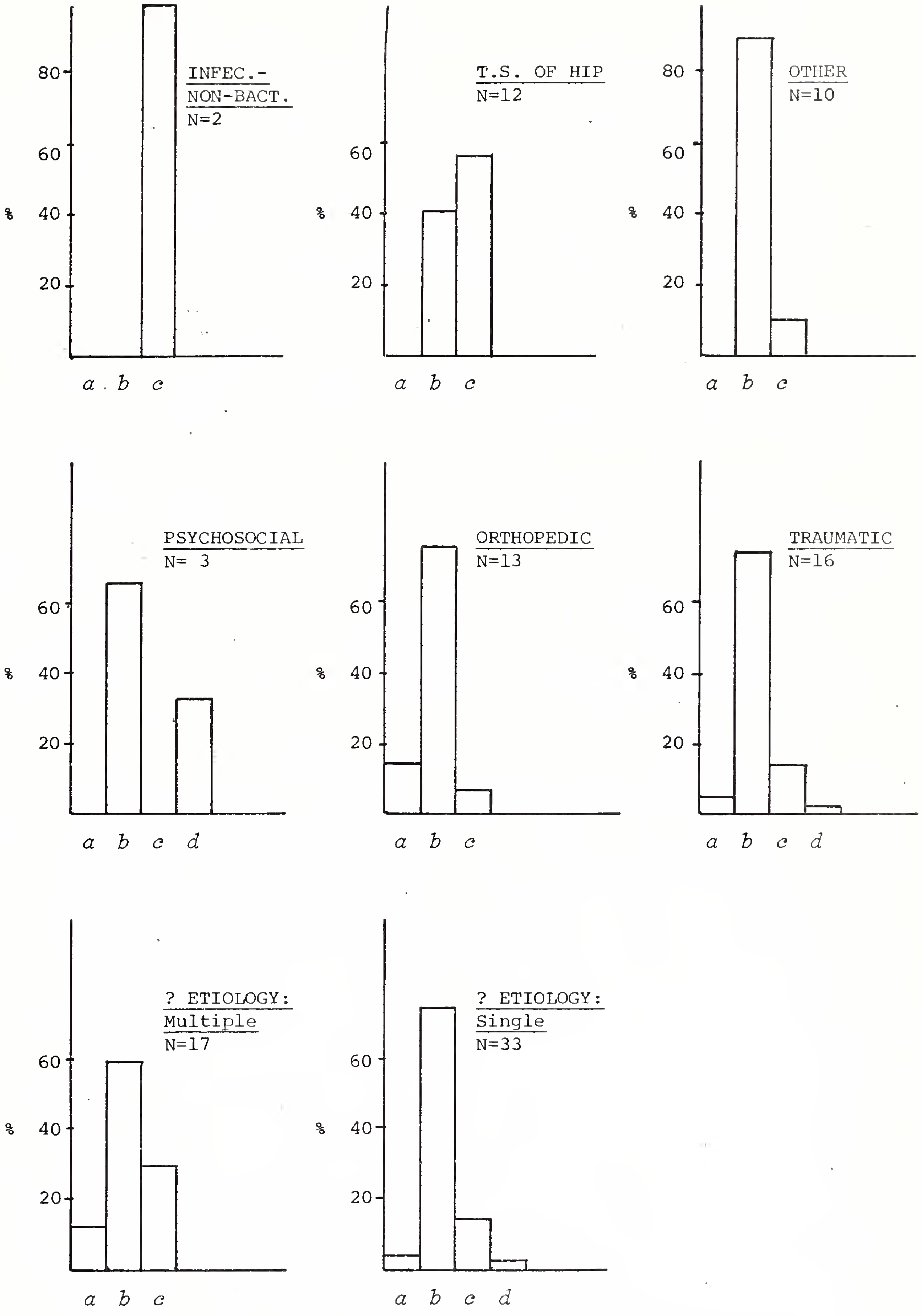


FIGURE 1-3: WHITE BLOOD COUNT
(Page 2)

shown in Table 1-22 and Figure 1-4, erythrocyte sedimentation rates ranged from less than 10 to over 60 mm/hr, with a mean value of 31 mm/hr. 74% of patients had ESR's measured, and the distribution for the whole group is fairly even over the range of values up to the level of 60 mm/hr.

Juvenile rheumatoid arthritis patients had the highest ESR's recorded, with values up to 90 mm/hr. 79% of patients had values ≥ 50 mm/hr.

Patients with acute rheumatic fever, septic arthritis and osteomyelitis also had mean values seventeen to twenty mm/hr higher than the mean for the entire study group. Children with cellulitis or other types of infections had elevated ESRs as well, but the mean values for these categories were slightly lower than those mentioned above.

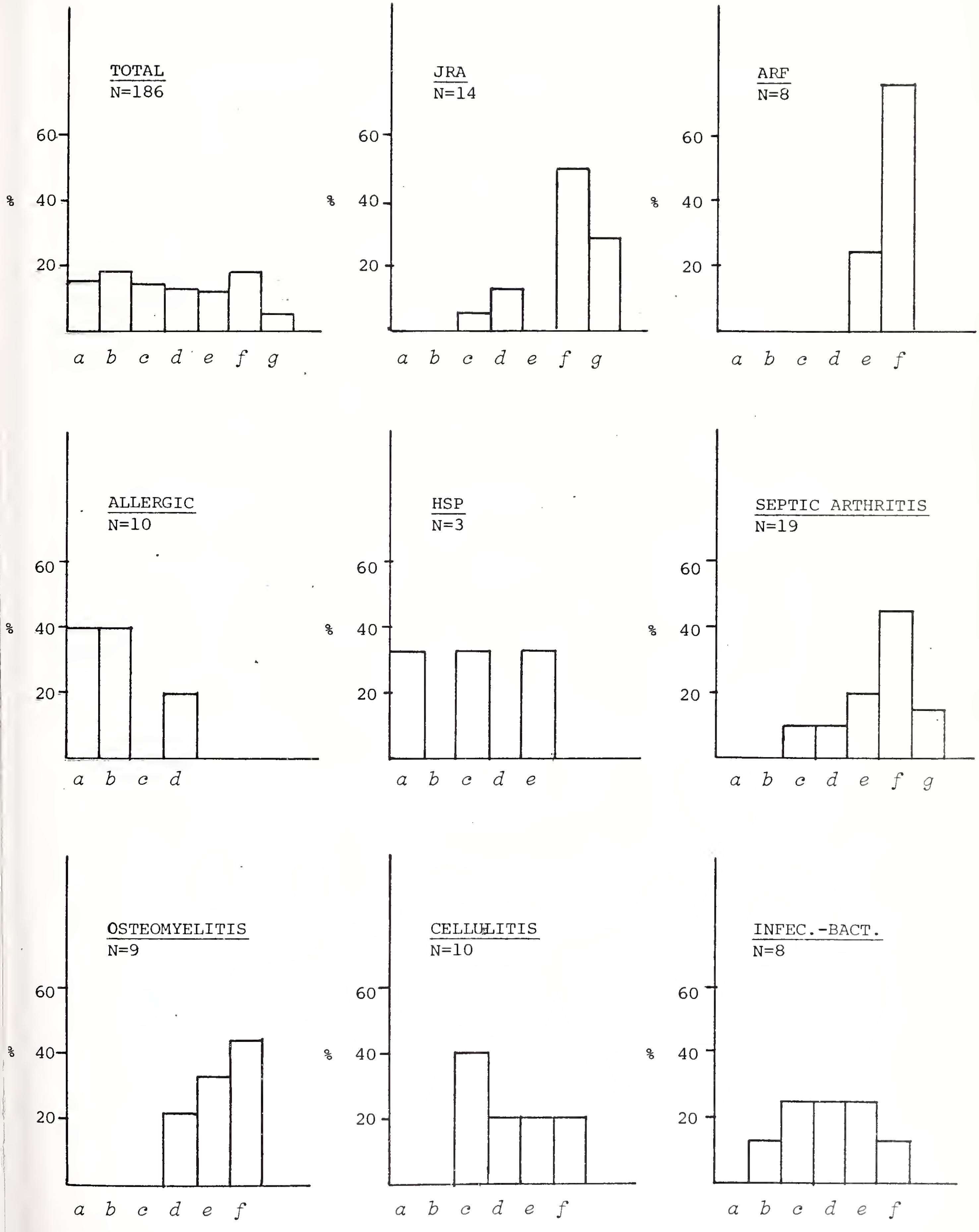
The allergic reaction group had normal to moderately elevated ESR's but there were no vlaues greater than 40 mm/hr.

Although one child with transient synovitis of the hip had an ESR of 46 mm/hr, the other determinations in that group were less than 30 mm/hr. That one child also had a concurrent upper respiratory infection, and a fever of 38.5°C.

Patients with traumatic injuries sometimes had elevated ESR's, but these were usually only moderately elevated. One value of 48 mm/hr was in a boy with a concurrent otitis media. 90% of the "orthopedic" patients had ESR's less than 20 mm/hr. One value of 58 mm/hr belonged to a paraplegic child with an unrecognized acutely fractured tibia.

1-22 Erythrocyte Sedimentation Rate (mm/hr)

	Number	Mean	Standard Deviation
Total	186	31	± 19
JRA	14	54	± 17
ARF	8	51	± 6
Septic Arthritis	20	49	± 13
Osteomyelitis	9	48	± 9
Infections-Non-B	3	46	± 7
Infections-Bact.	8	37	± 10
Cellulitis	10	35	± 13
Psycho-social	2	27	± 30
? Etiology-Multiple	17	26	± 16
H.S.P.	3	25	± 20
? Etiology-Single	37	23	± 15
Other	9	22	± 13
T.S. of hip	12	20	± 11
Allergic	10	16	± 12
Traumatic	15	16	± 11
Orthopedic	10	14	± 16



a = 0-9
b = 10-19
c = 20-29
d = 30-39
e = 40-49
f = 50-59
g = 60 or greater

FIGURE 1-4: ERYTHROCYTE SEDIMENTATION RATE (mm/hr)

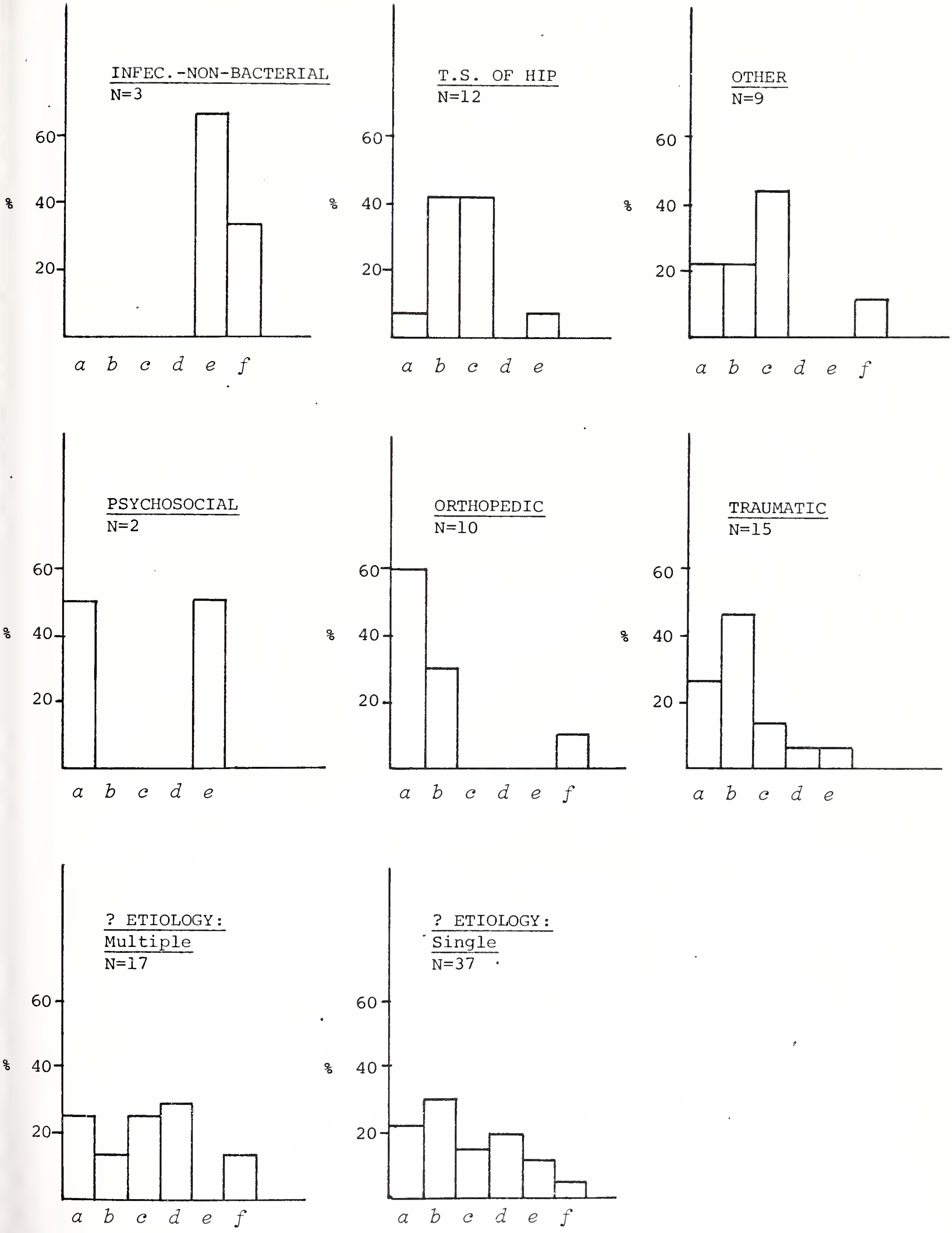


FIGURE 1-4 : ERYTHROCYTE SEDIMENTATION RATE (mm/hr)
(Page 2)

Radiographic examinations of the joints were done in 66% of cases, and 34% of these were positive. 22% showed non-diagnostic changes such as effusions (13%) or soft-tissue swelling (5%), but 12% showed abnormalities which directly led to a diagnosis (Table 1-23).

X-rays were most helpful in diagnosing orthopedic disorders. All nineteen patients in that group had x-rays taken, and fourteen were not only positive, but were diagnostic (74%).

Only four other patients had diagnostic x-rays: one had osteogenic sarcoma evidenced by a lytic lesion, two had osteomyelitis with bony lucencies, and the third was a battered child with an old fracture.

In the last two years of the study span a number of children underwent bone scanning as part of their diagnostic evaluation. Nineteen scans were done, 63% were positive and 37% were diagnostic. Five scans showed osteomyelitis, evidenced by increased uptake of radionuclide at the site of the infection. One scan was consistent with septic arthritis, and one with both septic arthritis and osteomyelitis. Three scans were positive but non-diagnostic (16%), and nine scans (47%) were negative (Table 1-24).

Culture results are presented in Tables 1-25 through 1-30. 40% of patients had blood cultures taken, 19% of these were positive. Staphylococcus aureus was the organism most frequently isolated, and was associated with cases of osteomyelitis, septic arthritis and bacteremia. Hemophilus influenzae was present in five children with septic arthritis or cellulitis.

JOINT X-RAY	NUMBER DONE	PERCENT POSITIVE	PERCENT DIAGNOSTIC
Total	164	34	12
Orthopedic	19	74	74
Infections - Non-B	2	50	-
Septic Arthritis	20	45	-
Other	10	40	10
JRA	14	36	-
Traumatic	16	31	-
Osteomyelitis	10	30	20
Cellulitis	7	29	-
ARF	4	25	-
? Etiology - single	35	23	-
Psycho-social	5	20	20
T.S. of hip	14	14	-
Infection - Bact.	5	0	-
? Etiology - mult.	2	0	-
Allergic	1	0	-
HSP	0	-	-

BONE SCANS

	NUMBER DONE	PERCENT POSITIVE	PERCENT DIAGNOSTIC
Total	19	63	37
Osteomyelitis	5	100	100
S.A. & Osteo.	1	100	100
S.A.	3	67	33
Orthopedic	3	33	
Traumatic	1	100	
Other	1	0	
Cellulitis	2	0	
? Etiology	3	0	

BLOOD CULTURES: POSITIVE 19/101 = 19%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	19	100
Organisms:		
S. aureus	11	58
H. influenzae	5	26
S. typhi.	1	5
D. pneumoniae	1	5
N. meningitides	1	5
Diagnoses:		
Osteomyelitis	6	32
Septic Arthritis	6	32
Osteomyelitis & Septic Arthritis	1	5
Sepsis	4	21
Meningitis	1	5
Cellulitis	1	5

THROAT CULTURES: POSITIVE 11/75 - 15%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	11	100
Organisms:		
*Beta hemolytic streptococci, Group A	8	73
Beta hemolytic streptococci, not A or D	1	9
*Hemophilus sp.	1	9
*H. influenzae	1	9
Diagnoses:		
ARF	2	18
HSP	2	18
Septic Arthritis	2	18
T.S. of hip	1	9
Cellulitis	1	9
Osteochondritis Dissecans	1	9
Viral Arthralgia	1	9
? Etiology - Single	1	9

* may be normal flora

JOINT FLUID CULTURE: POSITIVE 8/34 - 24%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	8	100
Organisms:		
S. aureus	2	25
H. influenzae	5	63
Beta Hemolytic Streptococci Group A	1	13
Diagnoses:		
Septic Arthritis	8	100

CULTURES OF SURGICAL SPECIMENS:

BONE OR SYNOVIAL TISSUE: POSITIVE 9/19 - 47%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	9	100
Organisms:		
S. aureus	8	89
Mycobacterium trivale	1	11
Diagnoses:		
Osteomyelitis	6	67
Septic Arthritis	2	22
Osteomyelitis and Septic Arthritis	1	11

WOUND CULTURES: POSITIVE 6/13 = 46%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	6	100
Organisms:		
S. aureus	4	67
P. aeruginosa	1	17
Beta Hemolytic Streptococci Group A	1	17
Diagnoses:		
Cellulitis	2	33
Osteomyelitis	1	17
Prepatellar Bursitis	1	17
Traumatic	1	17
Septic Arthritis	1	17

Rectal Swab or Stool Culture: Positive 3/19 - 16%

	NUMBER POSITIVE	PERCENT OF POSITIVES
Total	3	100
Organism:		
Salmonella spp.	3	100
Diagnoses:		
Sepsis	1	33
Enteritis	1	33
JRA	1	33

Throat cultures were performed in 30% of patients. Group A beta hemolytic streptococci were isolated in 73% of positive throat cultures. Only two patients (25%) with acute rheumatic fever had positive throat cultures. Three positive cultures probably represented normal flora.

Synovial fluid was cultured in thirty-four patients, with a positive yield of 24%. All eight children with positive joint fluid cultures, by definition, had septic arthritis. H. influenzae was isolated in 63%, S. aureus in 25% and group A beta hemolytic streptococci in 13% of patients.

Children who underwent surgical exploration and/or drainage of presumed septic sites had specimens of bone or synovial tissue sent for culture. Nine out of nineteen (47%) of these cultures were positive, and in 89% S. aureus was isolated. One child grew an atypical mycobacterium from a specimen of synovial tissue after three weeks of incubation. 67% of patients with positive bone or synovial tissue cultures had osteomyelitis. 22% had septic arthritis, and 11% both osteomyelitis and septic arthritis.

There were three positive stool or rectal cultures, all greww Salmonella species. One of the patients had enteritis only, another had salmonella bacteremia, the third was a child with juvenile rheumatoid arthritis.

Titers of antistreptolysin O (ASO) and antihyaluronidase (AHT) were measured in 38% of children, in an effort to recognize those with preceeding streptococcal infections (Table 1-31). 29% had negative tests: titers $\leq$ 1:32. Another 31% had titers which were equivocally

1-31 ANTISTREPTOCOCCAL ANTIGENS

	Number Done	% ASO or AHT $\leq$ 1:32	% ASO>1:32-1:128 or AHT>1:32-1:256	% ASO>1:128 or AHT>1:256
Total	94	29	31	40
JRA	13	62	8	31
ARF	8	0	13	88
Allergic	7	29	57	14
HSP	3	-	67	33
Septic Arthritis	12	58	8	33
Osteomyelitis	4	-	50	50
Cellulitis	2	-	50	50
T.S. of hip	4	25	75	-
Infection - Bacterial	2	50	-	50
Infection - Non-Bac.	0	-	-	-
Other	2	-	-	100
Psychosocial	1	100	-	-
Traumatic	4	75	-	25
Orthopedic	1	-	-	100
? Etiology- Multiple	15	20	33	47
? Etiology - Single	16	6	56	38

elevated: ASO titers from 1:40 to 1:128, and/or AHT titers from 1:40 to 1:256. 40% had significantly elevated values: ASO titers > 1:128 or AHT titers > 1:256. Although elevated titers were found in 88% of children with acute rheumatic fever, nearly every other diagnostic category included children with elevated titers to antistreptolysin O and/or antihyaluronidase.

The highest levels measured for the ASO determination were 1:320. AHT values ranged as high as 1:8192. Seven children had AHT titers greater than 1:1024. Three of these children had acute rheumatic fever, one had juvenile rheumatoid arthritis, one septic arthritis with a throat culture positive for beta hemolytic streptococci, and the remaining two had joint pain of unknown etiology.

Antinuclear antibodies (ANA) were measured in 81 patients (32%). There were three patients with positive titers (1% of the total study population). One child with pauciarticular juvenile rheumatoid arthritis had an ANA titer of 1:4, and negative tests for specific anti-DNA antibodies. A second child with pauciarticular JRA had an ANA titer of 1:64 with a peripheral pattern of fluorescence. Her DNA binding capacity was 7%. The third positive ANA titer was a value of 1:8 and belonged to a child with salmonella bacteremia and a knee effusion.

Rheumatoid factor, antibodies to IgG, was assayed in fifty children (20%), and was negative in forty-seven. Three children (1% of study population) had positive titers for rheumatoid factor. One girl with Sjogren's syndrome had a titer of 1:80. A child with

systemic JRA had a titer of 1:160. One girl with acute rheumatic fever had an elevation of 1:40; however, a second measurement one week later was normal.

The lupus erythematosus cell test (LE prep) was performed on the sera from fifteen patients. One child had a positive result, the same child who had pauciarticular JRA and an ANA titer of 1:64.

Eighteen children were screened with slit lamp ophthalmologic examinations. Two had evidence of acute or chronic anterior uveitis.

55% of the study population had follow up information in their charts. 45% were followed either by their private physicians, their group health plans, or they had no follow up examinations.

Discussion

A discussion of the results of this study will be divided into two sections. The first part will deal primarily with a review of the differential diagnosis of arthritis and arthralgia in children. Every possible diagnosis will not be discussed in detail, but the outline shown in table 2-1 should provide a fairly comprehensive list of those syndromes which may present with pain and/or swelling of the joints. This section will concentrate on the diseases as they commonly present, and will include data from this review when it is appropriate.

The second section will include a discussion of the process of evaluating a child with arthritis or arthralgia. Our experience, as well as the review of diagnostic possibilities presented in the previous section will be used as background in an effort to identify the most useful methods of clinical and laboratory investigation.

2-1 Differential Diagnosis of Arthralgia and Arthritis in Childhood

(* Indicates discussion in text)

I. Rheumatic Diseases

- *Juvenile Rheumatoid Arthritis
- *Acute Rheumatic Fever
- *Allergic Reactions
- *Henoch-Schonlein Purpura
- *Dermatomyositis
- *Systemic Lupus Erythematosus
- *Scleroderma
- *Ankylosing Spondylitis
- *Sjogren's Syndrome
- *Arthritis of Inflammatory Bowel Disease
- *Psoriatic Arthritis
- Mixed Connective Tissue Disease
- Eosinophilic Fasciitis
- Vasculitis
    - *Polyarteritis Nodosum
    - *Infantile Polyarteritis
    - *Mucocutaneous Lymph Node Syndrome

II. Infections

- *Septic Arthritis
- *Osteomyelitis
- *Cellulitis
- Pneumonia

2-1 Continued

- Bacterial Endocarditis
- *Viral Arthropathies
- Reactive (post-infective) Arthritis
    - *_Shigella_, _Salmonella_, _Yersinia_ Infections
    - Reiter's Syndrome
    - Syphilis

III. _Hematologic_

- *Malignancies
- Sickle-cell Anemia
- Thalassemia
- Hemophilia

IV. _Orthopedic_

- *Osteochondroses (Osgood-Schlatter, Legg Perthes', etc.)
- *Osteochondritis Dissecans
- *Slipped Capital Femoral Epiphysis
- *Other Knee Abnormalities
- Bone Cysts and Tumors
- Tenosynovitis

V. *_Trauma_

VI. _Miscellaneous_

- *Transient Synovitis of the Hip
- *Discitis
- *Lyme Arthritis
- Sarcoidosis
- Pigmented Villonodular Synovitis

2-1 Continued

VII. Psycho-social

- *Growing Pains
- Psychogenic
- Battered Child

VIII. Arthritis Associated with Immunodeficiency

IX. Metabolic

- Mucopolysaccharidoses
- Gout
- Lesch-Nyan Syndrome
- Familial Hypercholesterolemia
- Familial Mediterranean Fever

X. Nutritional

- Rickets
- Scurvy

XI. Congenital Abnormalities

Differential Diagnosis

An outline of the differential diagnosis of arthritis and arthralgia in childhood is presented in table 2-1. Our study did not include patients with every possible cause of joint pain, but did include cases of nearly every major disease listed (Table 1-3). The complete differential diagnosis includes a large number of rare disorders in which joint pain is a frequent manifestation, but an uncommon presenting symptom.

This discussion of the differential diagnosis of arthritis and arthralgia will focus on those diagnoses included in the study population, and those diagnoses in which joint symptoms are a predominant part of the clinical picture.

The division of diseases into diagnostic categories aids in creating a visually organized list, but at the same time creates somewhat arbitrary categories. The "rheumatic disease" classification is a vague grouping which at one time defined any non-specific condition characterized by joint inflammation such as rheumatic fever, rheumatoid arthritis or gout. More recently "rheumatic disease" has been used to define those conditions which are thought to be immunologically mediated, and which are sometimes associated with auto-antibodies.

The traumatic category includes disorders thought to be a direct consequence of a fall or other injury. It is sometimes difficult to assign patients to this grouping since an injury may

either be the cause of pathology, or only a precipitating factor which brings an underlying disorder to medical attention.

"Orthopedic" defines those syndromes which result from an alteration in the normal structure or mechanical function of a joint or bone and which are often referred to an "orthopedist." Fractures were included in this category when there was no direct history of trauma. (This is not to say that these are the only conditions an orthopedist treats).

"Psycho-social" is used to group those complaints which are thought to arise from emotional factors, i.e. psychogenic or psychosomatic illness. Cases of child abuse are also included here, since they represent deviation from the normal psychologic and social environment of the child.

Several diseases were listed under an "unknown etiology" classification. The pathogeneses of these disorders are either debated or undetermined.

The rest of the groupings should be self-explanatory.

Juvenile rheumatoid arthritis

Juvenile rheumatoid arthritis (JRA) is perhaps the most commonly thought of, most misunderstood and most confusing cause of arthritis and arthralgia in children. The disease was first recognized by a British medical student, George F. Still, and later reported by him in 1897. It is from his description that the eponym, "Still's Disease" evolved.

"There is a disease, occurring in children, and beginning before the second dentition, which is characterized clinically by elastic fusiform enlargement of joints without bony change, and also by enlargement of glands and spleen" (27).

Gradually it has become appreciated that classic "Still's disease" represents only one part of a spectrum of chronic arthritic diseases in children and this range of conditions is now known in the United States as juvenile rheumatoid arthritis, and in Great Britain as juvenile chronic arthritis.

Chronic is the key work in defining JRA. This is not a disease which develops one week and is gone the next. Several authors have developed diagnostic criteria for JRA; the criteria used in this study are those described by Schaller and Wedgewood in 1972 (10,24). 1) Onset must be at 15 years old or younger. 2) Chronic articular disease or systemic symptoms must be present continuously for at least six months. 3) Other disease must be excluded, such as: acute rheumatic fever, systemic lupus erythematosis, ankylosing spondylitis and infections.

In the last ten years it has become well recognized that juvenile rheumatoid arthritis has more than one clinical appearance and may represent

a spectrum of clinical conditions or diseases of varying etiology.

Classic Still's disease is now recognized as systemic onset JRA, and is seen in about 25% of patients with JRA (14). It is seen in males and females with almost equal frequency, is commonly seen in children between two and four years old, but about one third of those affected are older than ten years. In systemic onset disease articular complaints may be absent or minimal at the time of presentation, but they usually become manifest within the first year or two of the illness.

The prominent early symptoms are fever, rash and enlargement of lymphoid tissues. Fever is remarkably high, to 40 or 41° centigrade and commonly shows a pattern of diurnal swings. One or two prominent daily rises which often occur in the evening are followed by return to normal or subnormal temperatures. Fever of this nature is highly suggestive of JRA, but the fever pattern is not always so classic and JRA should still be considered in patients with prolonged relapsing, periodic or unremitting fevers. High fever is often accompanied by chills, malaise and anorexia which resolve when the temperature returns to normal.

The rash which distinguishes JRA is often difficult to see at initial examination but is an almost invariable component of systemic disease. Pale red macular or maculopapular blanching lesions of several millimeters' diameter, often with an area of central clearing, appear on trunk, neck and extremities. Individual lesions last for minutes to hours but the rash may recur daily for weeks to months. The rash may appear during periods of embarrassment, with a rise in external temperature or following skin trauma (isomorphic response). Commonly, the rash is most

prominent in the evenings during febrile episodes. Although the eruptions usually cause no discomfort, recently several cases of pruritis with the rash of systemic JRA have been reported. These children had typical appearing lesions, but they itched whenever the rash appeared and were relieved when it regressed. Antihistamines were of no benefit (20).

Hepatosplenomegaly and generalized lymphadenopathy are present to some degree in over 90% of patients with JRA. At times organ enlargement may be so massive that an underlying malignancy may be suspected. Furthermore, enlargement of mesenteric lymph nodes may cause abdominal pain of such severity that an acute abdominal crisis is questioned.

Pericarditis occurs to some degree in about one third of patients during the course of systemic onset JRA. Most frequently this is an incidental finding in a non-symptomatic child; but severe dyspnea and chest pain accompanied by cardiomegaly and congestive heart failure may require systemic corticosteroids for control.

Pleuritis is a relatively uncommon component of the disease which may be present on x-ray without clinical symptoms. Rarely interstitial lung infiltrates are also noted.

Examination of the joints in a child with systemic onset JRA may be perfectly normal. An early finding of articular involvement is guarding of the entire body, irritability, and an aversion to being held or touched. Pain and swelling with varying amounts of heat, effusion and limitation of motion develops in the first 6 months after the onset of disease.

Prognosis is sytemic onset JRA is variable. Some patients will recover completely within two years, but most will have well periods

interrupted by systemic recurrences for years with eventual recovery sometime before adulthood. About 25% will develop chronic deforming arthritis of one or more joints and be permanently disabled.

35 - 50% of patients with JRA will have a polyarticular disease, that is arthritis that has affected more than five joints. Patients who present with one or several joint involvement may progress to fit into the polyarticular category. This subgroup of JRA most resembles adult rheumatoid arthritis. There is a female predominance and two age peaks at two to four and ten to fourteen years old. Many of these children will present with low-grade fevers, anemia, malaise, irritability, and pain in one or several joints. By the end of six months numerous joints will be inflammed. Knees, ankles, wrists, and feet are involved in the majority of patients, the small joints of the hands are often afflicted, and 50% have disease of the cervical spine. The lumbodorsal spine is the only area spared. Hips are affected in one half of patients and are the most common cause of disability in this group.

While the systemic symptoms are not as prominent as in systemic JRA, some degree of lymphadenopathy and hepatosplenomegaly are frequently found and, mild anemia, malaise, irritability, and febrile episodes are common, during periods of active disease. These patients may develop rheumatoid nodules, rarely they have pericarditis or iridocyclitis. Rheumatoid rash usually is not associated with polyarticular disease.

The main cause of morbidity in this group is progressive joint destruction and retardation of bone development. Premature closure of the epiphyses may lead to deformities. Patients with temporomandibular

joint involvement are particularly prone to develop micrognathia. The worst prognosis belongs to those who have positive tests for rheumatoid factor and are older than eight years at the onset of disease.

Pauciarticular JRA is arthritis which has remained limited to four or less joints after six months of active disease, and it affects about 35% of patients with JRA. Large joints, especially knees, ankles, and elbows, are commonly affected, while the small joints of the hands and the hips are usually spared. Fever, malaise and other extra-articular symptoms occur less frequently than in systemic or polyarticular JRA. The joint disease is usually self-limited and non-destructive but 25 - 33% of patients will develop iridocyclitis, a disabling ocular condition which will be discussed in greater detail below.

Many patients who present with monoarticular or pauciarticular disease will gradually develop further joint involvement. In one study of 40 patients with monoarticular JRA 47% patients developed pauciarticular disease and 30% developed polyarticular disease within several years after onset (15). Of another group of 33 children with monoarticular onset 57% developed further joint disease (13).

There is no laboratory test that can establish the diagnosis of juvenile rheumatoid arthritis, nor is there any single finding which can rule it out. The test results vary widely, but the constellation of values may lend evidence for or against a clinical impression.

Anemia is a common finding, especially in children with systemic disease. While low hemoglobin levels can often be attributed to GI blood

loss secondary to salicylate therapy, anemia is often present before any medications are given. Although these patients often have low levels of serum iron they respond poorly to iron administration, as do many patients with anemias associated with chronic diseases.

Leukocytosis is a common finding, and is most pronounced in patients with systemic disease. While blood counts are frequently greater than 12,000 (cells per cu. mm.) and may be as high as 75 - 85,000. Often the differential cell count will show a striking predominance of granulocytic cells and an infection may be strongly suspected.

Erythrocyte sedimentation rate (ESR) is almost invariably elevated in patients with JRA, and is a fairly good indicator of disease activity. Levels reaching 60 - 80 (mm. per hr.) are not uncommon in JRA, but are also not diagnostic since infections, trauma and other inflammatory diseases may produce similar elevations. Serum albumin may be decreased and serum transaminase levels may be elevated in patients with JRA, perhaps reflecting subclinical hepatic involvement.

Serologic studies are abnormal less frequently in patients with JRA than in patients with adult-onset rheumatoid arthritis. Systemic JRA is not associated with positive titers for rheumatoid factors or antinuclear antibodies, but a significant number of children with pauci- and polyarticular disease will have positive serologic tests sometime during the course of their disease. Rheumatoid factors are found in 5 - 15% of patients with JRA, and are most common in patients with severe polyarticular disease and patients with rheumatoid nodules. Antinuclear antibodies (ANA) are found in about 15 - 25% of patients with JRA and are more common in girls

than in boys. Positive ANA test does not correlate with disease severity. LE Cells are found in 5% of patients; these are usually girls with chronic, severe arthritis (11,21).

Serum complement and immunoglobulin levels may be normal, elevated, or depressed in patients with JRA. The clinical significance of these determinations remains unclear (19).

Juvenile Rheumatoid Arthritis is associated with a kind of chronic ocular inflammation known as chronic iridocyclitis. This disease is extremely rare in children, but occurs in approximately 10% of patients with JRA (21,26). Although rarely or never seen in patients with systemic JRA it occurs in about 2% of children with polyarticular disease and in up to 30% of those with pauciarticular involvement. Chronic iridocyclitis occurs more commonly in girls and is bilateral in two-thirds of patients. The disease consists of an inflammatory process in the iris and ciliary body which results in the deposition of protein and inflammatory cells in the anterior chamber of the eye. While eye pain, and redness are occasionally present, the disease is usually asymptomatic in the early stages. Eventually fine adhesion known as posterior synechiae form between the anterior lens and posterior iris. These may produce an irregular constricted, non-reactive pupul which does not respond to mydriatics. Inflammatory debris, blocking the outflow tracts from the anterior chamber, produces glaucoma in about 25% of patients. Band keratopathy, the deposition of calcium salts in the interpalpebral area of the cornea, develops later in the disease course and may become extensive

enough to further decrease visual acuity. Cataracts form in up to 50% of affected eyes and are the third component of the "ocular triad of Still's disease": iridocyclitis, band keratopathy and cataract.

Iridocyclitis is a serious disease. Two thirds of those affected suffer permanent visual loss and up to one third will be blind in the affected eyes. There is a high correlation of the disease with children with pauciarticular JRA; and a very high correlation with those with pauciarticular disease and positive tests for antinuclear antibody. In fact, 88% of patients with antinuclear antibodies and JRA develop chronic iridocyclitis at some time. There is no correlation between eye disease and activity of arthritis; that is, eye disease may develop before onset, during activity, or after remission of joint disease. Since the early eye symptoms are often absent or unrecognized patients at risk need ophthalmologic examinations biannually. Slit-lamp examination demonstrates the earliest presence of inflammatory cells in the anterior chamber.

Acute iridocyclitis is characterized by the acute onset of red, painful eyes and blurred vision, and is not associated with positive antinuclear factor. It is rare in females and carries a good prognosis for visual acuity. Acute iridocyclitis is commonly found in patients with ankylosing spondylitis. Boys with peripheral arthritis and acute iridocyclitis who have been diagnosed as having JRA should be followed for evidence of sacroiliac and vertebral disease for they may in fact be suffering from early ankylosing spondylitis.

5.5% or fourteen patients in this review had juvenile rheumatoid arthritis. The diagnosis was considered in numerous other children and

misapplied in two cases. The fourteen cases are summarized in Table 2-2. Over fifty percent had systemic disease, probably a reflection of the selective referral of children with unknown febrile illnesses. One child with ANA positive pauciarticular disease had iridocyclitis. Another child had acute bilateral iridocyclitis and a febrile illness resembling systemic JRA with elevated white blood count, and symmetrical arthritis involving numerous joints. The fact that he was ANA negative and that his eye disease resolved rapidly suggests that he may have early ankylosing spondylitis.

2-2 Juvenile Rheumatoid Arthritis

	Age (yrs)	Sex	Duration of Symptoms	Fever ≥38°C	Rash	Hepato- and/or Splenomegaly	Hgb (gms)	WBC (WBC/mm^3)	ESR (mm/hr)
Systemic onset	4.8	5 M	23.4 days	100%	100%	37.5%	10.1	18,000	62.7
N = 8	(±2.1)	3 F	(±16.6)				(±1.8)	(±6,500)	(±11.6)
Polyarticular	12.6	1 M	4.2 years	-	-	-	11.1	7,000	58.0
N = 1			(intermittent)						
Pauciarticular	5.6	2 M	35.0 days	80%	-	-	11.7	10,100	40.0
N = 5	(±4.8)	3 F	(±38.9				(±1.4)	(±3,500)	(±16.3)

Acute Rheumatic Fever

Although the incidence of rheumatic fever has decreased markedly in the last fifty years, this disease still exists and needs to be considered when evaluating a child with joint symptoms. There were eight cases of acute rheumatic fever out of the 250 cases studied, an incidence of three percent of children who presented with joint complaints over a four year period.

Acute rheumatic fever usually manifests itself one to five weeks after an upper respiratory infection due to group A beta hemolytic streptococci. The disease is thought to result from an immunologic reaction triggered by the streptococcal organism which attacks connective tissue as well as smooth and cardiac muscle. While some patients may have no history of recent sore throat or illness, and many have negative throat cultures at the time of diagnosis, serologic evidence of recent streptococcal infection can be foung in over 95 percent (28).

Acute rheumatic fever usually occurs in children between five and fifteen years old with a peak incidence around six to eight years old. It is rarely seen over the age of fifteen and seldom if ever present in children less than three. Diagnosis is based on the application of the revised Jones' Criteria which are presented in Appendix A. The presence of two major criteria or one major and two minor criteria make the diagnosis of acute rheumatic fever probable but not certain. Evidence of a preceeding streptococcal infection would lend further support.

The clinical characteristics of acute rheumatic fever are somewhat variable, but about three quarters of patients will have joint pains. Articular involvement is classically "migratory," that is, as one joint becomes asymptomatic, another will become involved and the pain and/or swelling will seem to move from one site to another. Painful joints may be completely normal on examination or may show any combination of swelling, heat, redness or effusion. Elbows, wrists, ankles, and knees are most commonly involved, but other sites including the small joints of the fingers and toes may also be symptomatic. The usual duration of involvement of any one joint, if untreated, is between one and four days, although complaints of longer duration are not uncommon.

Skin involvement in acute rheumatic fever may take the form of a variety of non-specific rashes, but the rash of erythema marginatum, which occurs in a small percentage of patients, is characteristic and highly suggestive of the disease. Subcutaneous nodules may be present but are usually a late manifestation. They occur over the bony prominences or along tendon sheaths, and are more common in teenagers. Case #423, a fourteen year old girl, developed subcutaneous nodules over one tibia several weeks after she was diagnosed.

Chorea is rarely present in the early stages of acute rheumatic fever, although it may be the presenting symptom in a child with ARF who was previously asymptomatic. It is evidenced by jerky, involuntary movements of the arms and legs and, if present, is considered as one of the major criteria of disease.

Heart disease is the major cause of concern in patients with rheumatic fever. While some patients will show little or no evidence of cardiac involvement, others will have acute myocarditis or pericarditis, and a few will follow a chronic course with the eventual development of stenotic valvular lesions. Myocarditis should be suspected when a tachycardia disproportionate to the degree of fever is present. The electrocardiogram will be abnormal in cases of myocarditis. Pericarditis is a less frequent complication and is suggested by an elevation of the fever, chest pain, dyspnea and the auscultation of a friction rub.

Less common manifestations of acute rheumatic fever include abdominal pain, epistaxis, and rarely, rheumatic pneumonia. When the onset has been gradual, weight loss, anemia, pallor, malaise and fatigue may be prominent symptoms.

There are no laboratory tests which are diagnostic of acute rheumatic fever. The erythrocyte sedimentation rate is nearly always elevated, but may be in the normal range, especially in the presence of cardiac failure. Leukocytosis is common but not invariable. Throat cultures are positive for group A beta hemolytic streptococci in only about twenty-five percent of patients, but serologic evidence for preceeding stretococcal infection is present in over ninety-five percent if both antistreptolusin O (ASO) and antihyaluronidase (AHT) titres are measured (28). Chest x-rays and electrocardiograms should be screened for the possibility of carditis. Early EKG changes include prolongation of the PR interval, flattened T waves, and arrythmias.

In our series of eight patients there are four girls and four boys. Four were white, two black, and two of Spanish heritage. Ages ranged from 4.0 to 15.7 years, with a mean ag of 10.6 years. This is slightly higher than reported peak of six to eight years, but not of statistical significance. Knees were the most commonly affected joint, followed by ankles and hips. None of the children complained of wrist pain. Fifty percent had objective evidence of arthritis, and effusion was noted in only one child.

Only one patient had erythema marginatum. She also had fever to 40^{0}C, an elevated erythrocyte sedimentation rate and mild anemia. Surprisingly she had pain in the cervical spine and her ASO and AHT determinations were not significantly elevated.

Allergic Reactions

Drug reactions, allergic vasculitis, serum sickness and allergic synovitis were all grouped under the heading, allergic reaction, and together they accounted for 5% (14 patients) of the diagnoses in this study.

Serum sickness classically describes the reaction which occurs seven to twelve days after the injection of foreign serum. The acute onset of generalized urticaria is the most common symptom, but fever, lymphadenopathy, abdominal pain, headache, edema, myalgia, arthritis or arthralgia may also develop.

Today a real case of "serum sickness" is rare, but allergic reactions do occur in response to other antigenic stimuli. The spectrum of allergic reactions which may cause joint symptoms includes hypersensitivity to foods, drugs, and viral or bacterial antigens as well as to foreign serum.

In our group three reactions were attributed to penicillin, one was questionable related to the ingestion of "Actifed" and another to "Geritol". 57% of the children had antecedent illnesses, one child (7%) had a streptococcal pharyngitis.

A history of allergies was elicited in only three children, one of these had had a "serum sickness" type reaction following oral penicillin.

Diffuse, intensely pruritic urticaria is the hallmark of an allergic reaction, and it was present on examination of 71% of the

patients included in our allergic series. Another 14% gave a history of urticaria. Allergic reactions may produce non-specific, non-urticarial rashes. One child in our group had erythematous papules on his legs, arms and chest; another had non-pruritic macular lesions on the trunk and thighs. 100% of the patients with allergic reactions had rashes present at examination, or by history.

Diffuse edema of the hands, feet, lips and/or periorbital areas is a common component of an allergic syndrome. This was present to some degree in 64% of the children in our group. One child had edema of his entire forehead and scalp.

Fever and lymphadenopathy may be present for days to weeks after the onset of symptoms. The lymphadenopathy is usually mild. Fevers may be low grade or as high as 40°C. 29% in our group with allergic reactions had temperature $\geq$ 38°C., another 21% had low-grade fevers.

Joint manifestations usually follow the onset of skin eruptions by two to three days; and may be limited to arthraliga, or include swelling and effusions. Heat and erythema are uncommon findings. Knees, ankles and wrists are the joints most commonly affected. In our group knees were involved in 57%, ankles in 57%, and wrists in 14% of patients. 36% of children complained of pain or swelling of their fingers; and in one child the small hand and feet joints were the only ones affected.

Laboratory evaluation of children with allergic reactions is usually of limited value. White blood counts may be normal, elevated, or depressed. In our series, values ranged from 4,000 to 18,000 WBC/mm^3; with a mean of 9,300 WBC/mm^3. The 18,000 value may have been

a post-epinephrine blood sample.

Erythrocyte sedimentation rates may be normal or slightly increased, and an underlying infection may cause a greater than expected elevation. The mean value for our group was 16.2 mm/hr.

Analysis of joint fluid was not undertaken in any of the patients with allergic reactions in our review, but results usually show a white cell count in the range of 20,000 WBC/mm^3 with a predominance of polymorphonuclear leukocytes.

The diagnosis of allergic reaction is usually based on physical rather than laboratory findings. The specific antigenic cause is often not identified.

Henoch-Schonlein Purpura

Six children, or 2.3% of the group had Henoch-Schonlein Purpura (Anaphylactoid Purpura). This disease is characterized by a diffuse small vessel vasculitis which affects skin, joints, gastrointestinal tract, kidneys, and rarely, the central nervous system. The increased capillary fragility which underlies the condition is thought to result from an immunologic reaction triggered by hypersensitivity to bacteria, viral components, food, or other antigens.

Henoch-Schonlein Purpura (HSP) primarily affects children between the ages of two and eight years, and often follows or is concurrent with sore throat or upper respiratory infection. Onset may be acute or gradual and not every system is affected in every child. The hallmark of the disease is the rash, which classically appears as crops of petechial and purpuric lesions over the lower extremities and buttocks. The rash actually progresses through urticarial, macular or maculopapular, purpuric and ecchymotic stages. Petechiae may or may not be present. The crops of lesions may be of several millimeters to several centimeters in diameter and at any time lesions of several stages may be found. While the rash is often limited to the lower extremities and buttocks, the face, trunk and upper extremities may be affected as well.

Arthritis or arthralgia is transient and non-deforming. It most frequently involves knees, ankles and wrists, and may cause swelling, effusions and marked tenderness; but rarely causes

marked erythema or heat. Edema of the hands, feet, scalp and periorbital regions is often present in young children.

Gastrointestinal manifestations may include cramping abdominal pain, nausea, vomiting, hematemesis and/or melena. Hemature̶ruria is present in 20-40 percent of patients (32).

Laboratory data is non-diagnostic. White blood counts are usually moderately elevated, in the range of 10-20,000 WBC/mm^3. Erythrocyte sedimentation rates are greater than 20 mm/hr. in the majority of cases (32). Positive throat cultures or elevated titres to antistreptolysin O (ASO) are found in slightly higher proportion in patients with Henoch Schonlein Purpura than in children with non-streptococcal infections (35).

There were six children in this study with Henoch-Schonlein Purpura. They ranged in age from two to six years old, with a mean age of 4.5 years. All complained of joint pain and rash, three had histories of fever in the prior twenty-four hours, three had had sore throats in the preceding weeks, two had had upper respiratory infections two days and three weeks prior to presentation.

Two of the six children complained of abdominal pain and one of these had a positive benzidine test for stool blood. Three children had evidence of renal involvement during the course of their illnesses, as evidenced by microscopic hematuria. White blood counts ranged from 7,000 to 16,300 WBC/mm^3 and erythrocyte sedimentation rates were between 8mm/hr and 47mm/hr. The only child who had skin, joint, gastrointestinal and renal involvement

did have a history of a recent sore throat. However, her throat culture was negative, ASO was insignificantly elevated at a titre of 1:80, and AHT equivocally elevated at 1:512.

Henoch-Schonlein Purpura should be considered an important part of the differential diagnosis of children less than eight years old who present with joint pain and a rash.

Dermatomyositis

Dermatomyositis is a diffuse inflammatory disease of striated muscle and skin which can have its onset at any age from infancy through adulthood. Among children females are affected slightly more often than males. While there is a 20% incidence of underlying malignancy in adults with dermatomyositis, this association is only very rarely observed in childhood (38). The etiology is unknown, but is thought to involve a cell-mediated immune response to an unidentified antigen. A release of lymphotoxins from sensitized lymphocytes probably contributes to muscle injury.

Joint pain is not commonly the presenting symptom but arthritis or arthralgia frequently occur at some stage of disease. The classic history for dermatomyositis is an insidious onset of fatigue, and muscle weakness, especially of proximal muscle groups. Frequent falls, difficulty climbing stairs or rising from a seated position on the floor are common complaints. In retrospect many patients or parents identify a prodromal period of malaise, anorexia, fatigue or low-grade fever which preceeded the recognition of definite muscle weakness by weeks to months. At the time of presentation muscle tenderness is noted in most patients. About 20% complain of back pain, some give a history of Raynaud's phenomenon, others report a sensation of tightening of the skin (37).

Dermatomyositis implies involvement of the skin. Patients with muscle involvement but no rash have polymyositis. Those with skin and muscle manifestation have dermatomyositis. Dermatomyositis may present

before, after or simultaneously with the onset of muscle weakness. Characteristically a violaceous, erythematous rash appears around the eyes, over the malar eminence and along the extensor surfaces of the knees, elbows, metacarpal-phalangeal and proximal interphalangeal joints. The appearance of a rash with "heliotrope" hue in periorbital areas, across the knuckles and around the nail beds is considered highly suggestive of dermatomyositis. Less commonly the distribution may include V-shaped areas of the forehead and upper chest with marked erythema over the extensor surfaces of the extremities. The skin feels thickened due to dermal edema. Occasionally the rash may be indistinguishable from that associated with systemic lupus erythematosus.

Systemic manifestations are not as marked as in some of the other childhood rheumatic diseases. Over half of children will have mild to moderate fevers, and about 10% will have high spiking fevers. Subcutaneous calcinosis is only common after one to two years of disease (37).

Significant morbidity is related to gastrointestinal involvement (36). Some degree of vasculitis of the intestinal tract is probably present in all patients with dermatomyositis, but usually this remains asymptomatic (37). Perforation of the gut can and does occur and is a common cause of mortality in untreated patients. Other causes of death are secondary to infection, aspiration, palatal or respiratory muscle paralysis.

Laboratory determinations are very helpful in this disease and muscle biopsy is usually unnecessary to establish the diagnosis. Although hemoglobins, white blood counts, and serum complement levels

are usually normal, rheumatoid factor and antinuclear antibody titers usually are negative, and erythrocyte sedimentation rates are raised in only 50%; levels of the "muscle enzymes", creatinine phosphosphokinase (CPK), aldolase and serum glutamic oxalic transaminase (SGOT) are nearly always elevated during periods of active disease. Electromyographic studies (EMG) are also abnormal. Stools may show evidence of occult blood, and x-rays may reveal calcium depositis in the soft tissues.

Most children with dermatomyositis respond well to oral corticosteroid therapy. Management includes monitoring disease activity, preventing joint contractures and watching for evidence of complications. The work, "kick", cannot be pronounced by children with palatal paralysis and its pronunciation is a useful clinical test.

One child in our study had dermatomyositis with an atypical presentation. This 2.8 year old white male presented with a one month history of hip and ankle pain, and one week of rash and pretibial edema. He had had a pharyngitis due to group A beta hemolytic streptococci just prior to the onset of joint pain. At physical examination he had a typical violaceous rash around his eyes, over cheeks, arms, and knuckles, as well as pain and decreased abduction of his hips. CBC was normal, ESR was 29, LDH = 920, SGOT = 94, and CPK = 280. EMG was consistent with myositis. He did well on prednisone with gradual resolution of all symptoms over three years.

Systemic Lupus Erythematosus

There were no cases of systemic lupus erythematosus (SLE) in the review population, but this is a serious disease which may present with arthritis or arthralgia and which needs to be considered when evaluating children with joint symptoms. The exact etiology of SLE is unknown, but an auto-immune process has been implicated since patients exhibit serum antibodies against nuclear, cytoplasmic and serum antigens. Immunoglobulin and complement have been demonstrated in renal and skin lesions through the use of immunofluorescent techniques.

Some cases of systemic lupus erythematosus are thought to be drug induced. Hydralazine, procainamide, penicillamine and the sulfonamides have all been implicated, but the anticonvulsants are most commonly associated with drug-induced SLE in children (42).

Girls are affected four to five times as commonly as boys, and whereas boys may have disease onset at any age, girls have a peak incidence in adolescence.

SLE may first manifest itself with articular symptoms. In one study 42% of patients gave joint pain or swelling as a chief complaint (41). Joint manifestations may take the form of a symmetric polyarthritis, similar to the polyarthritis form of JRA; a migratory polyarthritis, as in ARF; or an arthralgia without objective findings as in a multitude of disorders.

Many children with systemic lupus are initially misdiagnosed. The facial rash of SLE is fairly characteristic and should elevate

the index of suspicion significantly. The classic rash consists of an erythematous eruption which is distributed in a butterfly shaped area over the bridge of the nose and cheeks. Scalp, neck, chest, and extremities may also be affected and the lesions are sometimes papulovescicular, petechial, or purpuric. Localized areas of alopecia are common.

Raynaud's phenomenon, photosensitivity, mucous mambrane ulcerations, pleuritis, pericarditis, and proteinuria, especially in combination, are suggestive of SLE. Weight loss, weakness, and fatigue are noted in about one half of patients. Fevers which may be low grade or high and spiking are also common. Central nervous system involvement may cause headaches, ataxia, psychoses, convulsions, bladder incontinence, chorea, peripheral neuropathies or pralysis.

The renal lesion in SLE is a significant source or morbidity and mortality. Early signs may include persistent proteinuria, hematuria, or the presence of cellular casts in the urinary sediment. Renal biopsy is necessary to assess the nature and severity of disease. Children with evidence of diffuse proliferative glomerulonephritis carry the worst prognosis.

Laboratory tests are particularly helpful in the diagnosis of systemic lupus erythematosus. Antinuclear antibody tests are positive in 100% of patients, LE cells are found in about 50% and rheumatoid factor in about 20%. The erythrocyte sedimentation rate is usually but not always elevated. Blood counts frequently reveal anemia, leukopenia, or thrombocytopenia.

While SLE can be essentially ruled out with a negative ANA test, children with arthritis or arthralgia and a positive ANA should be evaluated and followed for the appearance of systemic evidence of lupus.

Scleroderma

Scleroderma is a disease of connective tissue which may be limited to the skin and underlying tissue; or it may cause a diffuse illness with not only dermatologic, but also gastrointestinal, pulmonary, cardiovascular, and pulmonary manifestations. There is a female predominance in both varieties and the disease may present at any age.

The skin changes in both localized and systemic scleroderma are manifested by thickening of the skin and a tight, "hide bound" appearance. The lesions progress through three stages: edematous, indurative or sclerotic, and atrophic (37). Early edema may go unrecognized. Late changes of the face leave the patient with an expressionless appearance.

Localized scleroderma may affect only patches of skin; morphea; linear bands of skin which usually extend down an extremity: linear scleroderma; may affect entire regions of the body such as head, trunk, or extremity; or may take a diffuse, overall pattern. Patients with localized scleroderma often present with fixed flexion deformities at wrists, elbows, ankles, or other joints. These may be secondary to skin changes, but are often not associated with contraction of the overlying skin. Synovitis, evidenced by actual joint pain and swelling may also be present. Localized scleroderma may involve muscle and bone and may result in bony erosions, reabsorption and significant deformity.

Progressive systemic sclerosis is a life-threatening disease. Patients may present early in the disease with complaints of tightness, stiffness, decreased motion of joints; and some will actually have joint pain or swelling. Joint contractures of the fingers are common. Raynaud's phenomenon may precede the onset of symptoms by weeks to years.

Gastrointestinal involvement may be heralded by dysphagia. Decreased esophageal motility as well as small and large bowel abnormalities are part of systemic scleroderma. Cardiac problems include arrythmias and congestive heart failure. Pulmonary fibrosis may be picked up early as a decreased diffusion capacity, or may go unnoticed until cor pulmonale is evident. Renal disease may develop suddenly and rapidly progress to severe renal failure.

Laboratory tests are not diagnostic. Erythrocyte sedimentation rates, blood counts and urinalysis are usually normal. Barium swallow may reveal decreased esophageal peristalis in patients with systemic illness. Rheumatoid factor may be positive. Up to half of patients with localized disease and three quarters with systemic disease will have positive titres for antinuclear antibodies.

There were no patients in this review with scleroderma.

Ankylosing Spondylitis

Ankylosing spondylitis is a disease with a high familial incidence which leads to destructive changes in the sacroliac joints and the lumbodorsal spine. Many times more common in males than females, this disease is usually recognized in young adults. It is one of the conditions which is associated with the HLA B27 transplantation antigen.

In childhood ankylosing spondylitis may present with peripheral arthritis and only show classic clinical and x-ray changes in the spine and sacroiliac joints years later. Bywaters recently reviewed sixty-one children with onset of disease before age sixteen. The male to female ratio was five to one, and while the peak incidence was in children 11-15 years old, the youngest child was only three years old (47).

The peripheral arthritis may be confused with juvenile rheumatoid arthritis. While the hips and large joints of the lower extremities are most commonly affected, fingers and toes are not necessarily spared. Examination reveals warm, swollen painful joints with variable loss in motion. Only rarely does peripheral involvement cause destructive changes.

Back, sacro-iliac, thigh, groin or sciatic pain heralds the onset of chronic progressive disease and may be present early in the course or take twenty to thirty years to develop. Examination of the back may show decreased flexion and loss of the normal lumbar lordosis.

Ossification of the annulus fibrosis and the surrounding connective tissue of the intervertebral discs leads to progressive deformity. The diagnosis may be confirmed by x-ray changes in the back and sacroiliac joints. The earliest signs are blurring of the subchondral bony margin of the sacro-iliac joints.

Acute iridocyclitis occurs in about 25% of patients and rarely leads to significant visual loss. Complaints of redness, blurring or eye pain warrant complete opthalmologic evaluation. Although aortic insufficiency and cardiac conduction disturbances are seen in a significant number of adults with ankylosing spondylitis, these findings are rare in children.

Laboratory findings in children with ankylosing spondylitis are not diagnostic. The erythrocyte sedimentation rate will be elevated during periods of active disease, but may be normal at other intervals. Tests for rheumatoid factor and antinuclear antibody are negative. A mild hypochromic anemia may be present.

Differentiation from juvenile rheumatoid arthritis may be difficult. JRA may involve the scaro-iliac joints but back symptoms are usually limited to the cervical spine. Iridocyclitis is classically chronic in JRA as opposed to acute in ankylosing spondylitis. A positive family history of ankylosing spondylitis or the presence of the histocompatibility antigen B27 would support a diagnosis of ankylosing spondylitis over JRA.

Sjogren's Syndrome

Sjogren's syndrome is a rare disorder which rarely presents in childhood. However, one of the children in this review was diagnosed as having Sjogren's syndrome. She was a 9.5 year old Hispanic girl who presented with a three month history of shoulder and knee pain, daily fever spikes to 38.3°C., and itchy eyes. One year prior she was treated for shigellosis. Her aunt had rheumatoid arthritis. Physical examination was negative with the exception of a positive Schirmer test. Hemoglobin and white blood count were normal and erythrocyte sedimentation rate was 18. X-rays of joints and chest, blood, throat, stool, and urine cultures were negative. ANA was negative, but RF was positive with a titre of 1:80.

Sjogren's syndrome is a chronic inflammatory disease which usually develops in menopausal or postmenopausal women, and most often presents with complaints of dry eyes and dry mouth in a woman with rheumatoid arthritis. In 10% of cases, eye and mouth symptoms are the presenting manifestations. 10% of those afflicted are male (50).

The classic triad of Sjogren's syndrome includes keratoconjunctivitis sicca (dry eyes due to decreased lacrimal gland secretion), xerostomia (dry mouth due to decreased salivary gland secretion, with or without salivary gland enlargement) and rheumatoid arthritis. While some patients have only eye and mouth involvement, others may develop SLE,scleroderma, polymyositis or polyarteritis nodosa. Pseudolymphomas or reticulum cell sarcomas occur in some patients.

Mucosal dryness is often generalized and patients may suffer from epistaxis, hoarseness and chronic bronchitis.

Occular symptoms include burning, itching and a sensation of sand in the eyes. Schirmer's test measures the rate of tear formation and provides a crude estimate of lacrimal gland function. Corneal erosions may develop and can be demonstrated by fluorescein dye staining.

Salivary gland dysfunction leads to a dry mouth, decreased sense of taste and difficulty swallowing solid foods. The buccal mucosa takes on a parched appearance and the tongue becomes beefy and red. Salivary scintigraphy has become an aid to diagnosis of parotid disease.

Biopsy of the lower lip often demonstrates lymphoid infiltration in patients with Sjogren's syndrome. Some patients will have circulating antibodies against salivary gland tissue which can be demonstrated by indirect immunofluorescence.

Other laboratory tests may be quite helpful in diagnosing Sjogren's syndrome. 90% have rheumatoid factor in their serum, 70% have antinuclear antibodies, and 15% positive LE preps. Anemia, leukopenia and elevated ESR are common, but not invariable. Hypergammaglobulinemia is present in 50% (6).

Although this disease is interesting in that it shares components of a number of the other "rheumatic" diseases, it is not usually part of the differential diagnosis of arthritis and arthralgia in childhood.

Arthritis Associated with Psoriasis or Inflammatory Bowel Disease

The association between psoriasis and arthritis has been recognized for over a century and a half; while it has only been in the last thirty years that arthritis has been noted to be a common extragastrointestinal manifestation of inflammatory bowel disease (52,53).

Although arthritis associated with psoriasis is more common in adults, it may be the cause of joint pain in children with psoriasis as well. It affects girls twice as often as boys; may have its onset at any age, with a peak incidence at the time of puberty, and usually has an acute onset. Arthritis may precede the skin changes of psoriasis by up to nine years, or follow them by up to fourteen years. (53). Patients may have positive tests for RF or ANA. Sacroilitis develops in about 25% and acute iridocyclitis in about 10%. This form of arthritis may result in permanent deformity.

The peripheral arthritis of inflammatory bowel disease occurs in about 20% of patients with ulcerative colitis and about 10% of patients with granulomatous bowel disease. Arthritis usually follows the first onset of gastrointestinal symptoms but may occasionally precede bowel disease. Knees, ankles, elbows and wrists are most commonly affected, but the small joints of the hands and feet are not necessarily spared. Swelling, warmth and decreased range of motion may be present, but some patients only have joint pain.

Patients with joint complaints, and gastrointestinal complaints, weight loss, anemia, arrested growth and fever should be suspected of having inflammatory bowel disease.

Polyarteritis Nodosa Syndromes

Polyarteritis nodosa is primarily a disease of adults, although children are sometimes affected. A subgroup of the disease which affects children less than one year old, infantile polyarteritis, has been described, and recently a polyarteritis-like syndrome, the mucocutaneous lymph node syndrome, has been noted with increasing frequency in Japan and occasionally in the United States.

Adult polyarteritis nodosa is a multisystem disease characterized by inflammation of medium and small sized muscular arteries. Vessel necrosis, thrombosis and/or aneursymal dilatation are part of the disease process. Adult-type polyarteritis is rare in children, and affects males more frequently than females.

Generalized symptoms include fatigue, anorexia, malaise, weight loss and fever. Cutaneous lesions, arthritis or arthralgia, and myalgia are common. Involvement of gastrointestinal vessels may produce abdominal pain, ulcers and melena. Renal lesions are manifested by hematuria, hypertension or flank pain. Cough, wheezing, and pulmonary infiltrates are secondary to lung involvement and seizures, strokes, peripheral or cranial nerve palsies secondary to cental nervous system lesions. Involvement of the coronary arteries may lead to tachycardia, congestive heart failure, myocardial ischemia or infarction.

Elevated ESR, anemia, and occasional eosinophilia are common in adult polyarteritis.

In childhood fever, leukocytosis and abdominal pain are prominent symptoms, and renal or central nervous system involvement is common.

Infantile polyarteritis nodosa is a disease of children less than a year old. It affects both sexes with similar frequency. Fever, cough, and rhinitis are often the initial symptoms; conjunctivitis and a macular, erythematous rash are also common. Significant morbidity and mortality is associated with lesions of the coronary arteries. Tachycardia, cardiomegaly, congestive heart failure or pericarditis signal serious cardiac pathology.

Infantile polyarteritis nodosa is a rare disease, but recently a similar syndrome has been reported which affected at least 6,000 children in Japan between 1960 and 1974 (56). The mucocutaneous lymph node syndrome has also been recognized as a cause of disease and of death in the United States (54).

Most of the children with the MLNS are less than five years old, 50% are under two. 1-2% have died suddenly from coronary artery thrombosis. Fever in the range of 38.3-40°C., which is present for one to two weeks, and which does not respond to antibiotics is present in 95%. Congestion of the ocular conjunctivae produces red eyes in 88%. A reddish appearance of the lips and oral cavity, as well as a "strawberry" tongue with prominent papillae has been noted in over 75%.

Skin changes are present in nearly all the children affected. A macular, erythematous rash appears three to five days after the

onset of disease, and may be preceded by reddening of the palms and soles. The cutaneous lesions enlarge and coalesce over the next several days. Desquamation of the fingers and toes occurs during the second week of illness.

While arthritis and arthralgia are often present, they may be overshadowed by marked indurative edema of the hands and feet. Diarrhea, proteinuria and acute non-purulent lymphadenopathy are other manifestations.

Laboratory data usually shows leukocytosis, and elevated, ESR. Electrocardiography may document myocarditis or pericarditis.

Young children with fever, rash, arthritis, or arthralgia and suggestions of the other clinical manifestations of MLNS should be carefully evaluated as this is a potentially fatal illness.

Septic Arthritis

Septic arthritis should be high on the differential diagnosis of a young child with monoarticular joint pain and swelling, temperature greater than 38°C., elevated white blood count and erythrocyte sedimentation rate, and a hot, erythematous, painful swollen joint. Classically, the disease is usually located in hip, knee, ankle, or elbow and is most likely to be cause by Hemophilus influenzae or Staphylococcus aureus. Unfortunately this disease is not always easy to recognize. Although ESR is almost invariably elevated, white blood count may be normal, fever low-grade, joint findings minimal, x-rays negative and more than one joint may be involved.

Septic arthritis accounted for symptoms in 8% of our population. Twelve patients (60%) had a bacterial etiology confirmed by positive culture of blood, joint fluid and/or joint tissue. Two additional patients (10%) had gram positive cocci seen on gram stains of joint fluid, but negative cultures. Six patients (30%) had negative cultures but were thought to have septic arthritis after evaluation of clinical presentation, ESR, WBC, joint, aspiration results, and/or findings at surgery of the affected joint. In Nelson's review of 221 patients with septic arthritis bacterial etiology was not established in 33.5% of cases so although our results may have a disappointing low yield of positive cultures, they are not inconsistent with others' experiences (66).

Septic arthritis is much more common in young children. In our group the mean age was 4.4 years, 50% were less than three years old and 85% less than ten. Sixteen children had monoarticular involvement,

two had disease in two joints and one child had four affected joints. Nelson's large review reports monoarticular involvement in 90% of patients and knees, hips, and ankles, in decreasing order, as the most commonly involved sites (67). Our study included infections of the knee in 45% of patients, the hip in 25%, and the ankle in 15% of patients. Although septic arthritis of small, non-weight bearing joints is uncommon, it has been reported, and isolated involvement of one or more joints of the fingers or toes should still be evaluated for the possibility of bacterial arthritis (67).

The duration of symptoms is usually less than a week in septic arthritis. In our group over 50% had symptoms for two or less days, and the mean duration was 4.5 days.

Pain may be moderate to severe. Four of our patients refused to bear weight. Some of our patients who were old enough to talk complained of pain, but infants may be brought to the physician because of fever, irritability, joint swelling, or a pseudoparalysis of the limb or limbs.

Trauma has been considered as a predisposing factor in septic arthritis, but no studies have definitely defined its role. Some cases of septic arthritis are certainly induced by a penetrating injury to the joint. In one of our cases the child suffered a puncture wound to the knee four days prior to the diagnosis of septic arthritis. Nelson reported antecedent trauma to be present in 33% of his cases of septic arthritis (67). 35% of the patients in our series gave a history of injury to the affected site one to five days before the onset of symptoms.

Infectious arthritis may be a part of a total septicemic picture. 30% of our patients had positive blood cultures, and two children grew H. influenza from joints, blood, and other additional sites. The role of non-bacterial infection in the pathogenesis of septic arthritis has not been delineated. Antecedent illness was present in 35% of the patients in our review. Four children had non-specific viral illnesses, one had varicella, and one had had a streptococcal pharyngitis, treated with penicillin, three weeks prior.

Every child in our series of septic arthritis was febrile. Temperatures ranged from 38.0°C to 40.1°C, and the mean value was 39.0°C. Three children had skin eruptions of which two were non-specific papules, and the third was a healing varicella rash.

Children with septic arthritis almost invariably have positive joint examinations. All but two of the children in this series of twenty had joint pain or guarding. None had completely negative examinations. Patients with early septic arthritis may not exhibit joint swelling or effusion, and when the hip is the site of infection these findings are particularly difficult to demonstrate. Swelling or effusions were noted for 93% of the patients in our group who had septic arthritis of joints other than the hip. One child with infection of the ankle had no swelling or effusion present when he was first diagnosed, but swelling did develop over the next twelve hours.

Heat is frequently a characteristic of septic joints, and erythema is common, but not invariably present. In our group 50% exhibited joint heat, and 16% joint erythema.

White blood counts and erythrocyte sedimentations rates are usually significantly elevated in patients with septic arthritis. In our group the mean white blood count was 12,300 WBC/mm^3, but values ranged from 6,400 in a child who grew S. aureus from blood and joint fluid, to 20,200 in a child with arthritis and H. influenzae septicemia. Erythrocyte sedimentation rates were consistently elevated with a mean value of 49 mm/hr, and a range of 22 to 62 mm/hr. X-rays were normal in 45%, showed effusions in 35%, and non-specific changes in 20%.

The examination of joint fluid in patients with septic arthritis classically reveals cloudy yellow or yellow-green fluid with greater than 100,000 WBC/mm^3, equal or greater than 75% polymorphonuclear leukocytes, and glucose values less than 25 mg/100 ml (6). Joint aspiration was performed in fourteen patients of our group with septic arthritis, and the results demonstrate the variability and unreliability of this test. The number of total white blood cells ranged from 3,600 WBC/mm^3 to 202,000 WBC/mm^3, and the mean was 109,000 WBC/mm^3. However, three children with culture positive joint fluid had cell counts less than 40,000 WBC/mm^3. Ten children had joint protein measured and these ranged from 3.2 to 6.0 grams, with a mean of 4.9 grams. The glucose was determined in nine samples, but was less than 25 mg/100 ml in only four. The mean value for glucose was 53.3 mg/100 ml, and one determination was 170% of the serum glucose level.

Although H. influenzae, S. aureus, and the streptococci are the most common etiologic agents responsible for arthritis in children,

over eighteen different organisms have been cultured from patients with pyogenic arthritis. The staphylococci and enteric gram negative organisms are most common in infants less than six months old, and *H. influenzae* most common in children from six months to two years old.

Blood cultures were positive in 35% of patients in our series. Four children grew *H. influenzae*, three grew *S. aureus*. Joint cultures were positive in 45%. Three of these grew *H. influenzae*, four grew *S. aureus*, one grew beta hemolytic streptococci - group A, and one *Mycobacterium triviale*. Complete culture results are summarized in tables 1-25 and 1-30. One patient had both septic arthritis and osteomyelitis due to *S. aureus*.

H. influenzae arthritis is often associated with a systemic illness. 80% of the patients in this study with *H. influenzae* arthritis also had a septicemia. One child had blood, throat, and conjunctival cultures positive for *H. influenzae*, and another was severely ill with arthritis, cellulitis and a pericardial effusion which were all due to *H. influenzae*.

Of special interest is the inclusion, in the group with septic arthritis, of a patient with arthritis secondary to *Mycobacterium triviale*, an atypical mycobacterium, which is usually thought to be non-pathogenic. A discussion of the atypical mycobacteria will not be attempted here, but the issue of tuberculous arthritis is an important one.

Although the incidence of tuberculosis has decreased significantly in the last century, it is by no means an unseen entity. In Nelson's

study of septic arthritis one of the two hundred twenty one patients (0.5%) had tuberculous arthritis (66). This is certainly a more realistic percentage than the 5% which our study produced, but it demonstrates the necessity of considering tuberculosis in the differential diagnosis of pyogenic arthritis.

Tuberculous arthritis is often difficult to demonstrate. In one series of twenty-five patients with tuberculous arthritis there were two children, seven and nine years old, neither of whom had any constitutional symptoms (68). The disease occurs in less than one percent of patients with tuberculosis and may present with normal white blood count, normal x-ray and normal or low-grade temperature. Slight malaise or weight loss are not uncommon. Typically the arthritis develops insidiously, is monoarticular and affects weight-bearing joints. The first sign in a child may be a limp or pain which awakens the child at night.

Diagnosis of tuberculous arhtritis is made on the basis of finding acid-fast bacilli on culture and/or typical granuloma formation on synovial biopsy. Nearly all patients will react to skin testing. This should be included, and tuberculosis considered, in the evaluation of a patient with arthritis or arthralgia. Joint fluid may be stained for acid-fast bacilli and sent for AFB culture.

Gonococcal Arthritis

Although there were no reported cases in this review, the possibility of gonococcal infection should be considered in any child being evaluated for arthritis or arthralgia regardless of age or sex. In one study of bacterial etiology in childhood septic arthritis Neisseria gonorrhoeae was isolated -rom 5.9% of 221 patients(66). 85% of these children were prepubertal and the disease was not limited to females. Children may contact gonorrhea during birth; as young children, from close contact with infected parents or other caretakers; and at any age from venereal contact. The incidence of venereal infection in the adolescent age group has been rising steadily in the last 10 years and the low percentage of adolescents in various studies of pediatric arthritis may refelct a use of gynecologic over pediatric medical services.

Arthritis is the most common manifestation of systemic spread of genitourinary gonorrheal infection, and is thought to represent a hematogenous seeding of the synovium.

Articular pain and swelling are the most common presenting symptoms in patients with gonococcal arthritis and may or may not be associated with a fulmmant systemic illness. The full clinical picture of gonococcemia includes the rapid onset of fever, chills and malaise. A migratory arthritis sequentially involves several to many joints with some sites recovering while others begin to cause discomfort. Early in the course these joints may not be swollen but eventually the process localizes to one or more joints and causes pain, heat, swelling, and discomfort with motion. The skin

rash,when present, usually progress from small erythematous nodules to petechial, vesicular and/or pustular lesions, with many stages visible at one time. 1+ commonly affects the hands.

It would be misleading to consider gonococcal infection only when patients have the full-blown clinical picture. Only about one-third will exhibit a rash, one quarter will have monoarticular disease, and some will have only monoarticular disease without rash, fever, or other systemic symptoms.

Because Neisseria gonorrhoea is a fastidious organisms, blood, joint, vaginal, urethral or rectal specimens should be carefully cultured on appropriate media. Most importantly, this disease should be considered in patients with arthritis or arthralgia despite the fact that its discovery might cuase embarassment to patient, family, and physician.

Osteomyelitis

Although osteomyelitis, by definition, is an infection of bone and not joint, it may present with articular pain or swelling. In our series there were eight children with osteomyelitis, one with presumed osteomyelitis, and one with osteomyelitis and septic arthritis, in total composing 4% of our population.

Osteomyelitis has a predilection for grouping bone: in several large series over 85% of patients hospitalized for this disease were children (70, 75).

It has been hypothesized that the existence of sinusoidal veins with slow, turbulent flow and inefficient phagocytic cell linings make the metaphyses especially susceptible to infection. Long bones are most commonly affected. Our series of ten patients is compared to a series of one hundred sixty-three children published in 1975 by Dich et. al. in which 32% had involvement of the femur, 22% of the tibia, and 14% of the humerus (72). 90% of the patients in our group had involvement of femur or tibia. The one undocumented case of osteomyelitis was presumed to be humeral.

The child with osteomyelitis usually appears toxic. The onset of illness may be days to months prior .to presentation, but was less than one week in 71% of patients in the 1975 study (75). Our patients cited onsets from three hours to two weeks before presentation, with a mean of 5.7 days. Pain is the most common presenting complaint and was reported by 80% of our patients. One infant was brought to

the hospital because of irritability and refusal to move his right leg.

A history of antecedent trauma may be elicited in about one-third of patients, although its role in precipitating osteomyelitis is unknown (75). In our group three patients reported direct injury to the affected limb, and two other patients reported possible predisposing events. The patient with shoulder pain lifted weights as a hobby. A one-month old boy had had a "plastibell" circumcision apparatus on his penis for four weeks, and although there was no evidence of infection, signs of venous stasis were observed around the glans.

The role of antecedent infection is also unknown but the incidence of prior illness has been reported as 28%, and was 30% in our group (72). Fever $\geq$ 38°C. is present in many children with osteomyelitis and although temperatures may be as high as 39 or 40°C., they may also be normal. 80% of the patients in our series had temperatures $\geq$ 38°C., the mean was 38.7°C.

Tenderness is an important clinical sign in osteomyelitis in that it may be localized directly over the site of infection. Spread of infection from the metaphysis may be lateral and lifting of the periosteum may produce localized heat, erythema, and swelling. In four of our patients with osteomyelitis physical findings were present in areas displaced from the joint, over the actual location of infection. Examination of the joint may reveal pain, decreased range

of motion, heat, erythema, swelling or effusion. An effusion may be secondary to concurrent septic arthritis; or it may be a sterile, non-purulent fluid formed in reaction to the adjacent bony inflammation. This reaction may be secondary to a local vasodilation or to an immunologic process, and is called a "sympathetic effusion."

White blood counts are not a reliable tool in diagnosing osteomyelitis. About 40% of children in Dich's review had counts $\leq$ 10,000 WBC/mm^3 and in our group, values ranged from 4,300 to 16,500 with an average of 9.400 WBC/mm^3. Although ESR may also be normal, this would be unusual and values are usually markedly elevated. The mean in our study was 48 mm/hr.

The classic x-ray findings in osteomyelitis include lytic lesions, lucencies and irregularities due to bone destruction, and/or densities secondary to periosteal new bone formation. 30-50% of bone mineral must be eroded before a lytic lesion is visible. These findings are not evident, however, until ten to twelve days after the start of the pathologic process, and are usually not present when the child presents to hospital or physician. The earliest radiographic changes take one to three days to appear and are related to changes in soft tissue rather than bone. Swelling of soft tissues deep to the surface, in the area of metaphyseal infection, may cause displacement of the muscle plane away from the bone. Later swelling of the muscles themselves will obliterate the lucent planes normally visible between the muscles. These changes are subtle and are most easily

found by an experienced radiologist on comparison views of both extremities. Superficial subcutaneous soft tissue edema develops several days after onset and should be visible to the less experienced eye (

Lucencies were seen on x-rays of two patients in our group at the time of admission. Both children had had symptoms for twelve or more days.

Recently the diagnosis of osteomyelitis has been made much easier through the use of bone scanning. Radiopharmaceuticals, injected two to three house before scanning, localize in areas of osteomyelitis. This increased uptake may be a consequence of increased delivery of the radiotracer secondary to increased blood flow and/or increased metabolic activity at the site of infection. Six of the patients in the group underwent bone scanning as part of their diagnostic evaluation, and all six had increased uptake of radiotracer at the site of osteomyelitis. Bone scanning may be of further aid by identifying patients with osteomyelitis who have additional foci of infection, which are not initially clinically apparent. (The use of bone scanning in differentiating osteomyelitis from septic arthritis and cellulitis will be discussed in a subsequent section).

Although a large variety of organisms may cause osteomyelitis, _S. aureus_ is the most common etiologic agent in all age groups. _H. influenzae_ is common in children less than four years old, the streptococci in all age groups, _S. epidermidis_ may be cultured as

pathogen or contaminent, and P. aeruginosa is especially common in osteomyelitis following deep puncture wounds.

Patients with sickle cell anemia and Salmonella infections not uncommonly develop osteomyelitis as a complication of their disease(75). Bone pain in these children may be attributed to sickling and the osteomyelitis missed unless proper culturing reveals the organism and x-ray changes of osteomyelitis are observed. Bone scanning may help to define the underlying process before culture results are available or x-ray changes develop.

Hematogenous spread of tubercular bacilli or gonococci may lead to osteomyelitis and culturing should be adequate to investigate the possibility of tuberculosis or gonorrhea as underlying infectious agents (69). Any child suspected of having osteomyelitis should be skin tested for tuberculin sensitivity.

Surgical specimens of bone may be necessary to establish a bacteriologic diagnosis. 30% of the patients in this series were diagnosed on the basis of positive blood culture, 20% through positive bone culture and 40% through positive bone and positive blood cultures. One patient grew S. epidermidis from one of four blood cultures and did not undergo surgery or needle biopsy in order to obtain a bone specimen. It was unknown whether this represented a contaminent or pathologic agent.

Cellulitis

Cellulitis is not a disorder of articular surfaces or structures, but it frequently presents with joint pain and swelling and must be differentiated from other joint infections. The disease is characterized by the spread of pyogenic organisms between and within soft tissue spaces. It may be caused by direct innoculation of tissue from a penetrating injury, or arise from hematogenous spread of organisms. Beta hemolytic streptococci, S. aureus, and H. influenzae are the most common agents.

The beta hemolytic streptococci produce fibrinolysins and hyaluronidases which bread down connective tissue and facilitate extension from an infected focus. Streptococcal infections may invade the lymphatics and produce lymphangitis. H. influenzae is a common cause of cellulitis in young children, and may produce isolated cellulitis or systemic illness with bacteremia and numerous foci of infection. Cellulitis over a joint may be associated with an underlying septic arthritis.

Characteristic physical findings in patients with cellulitis include localized warm, erythematous, tender, boggy and indurated skin. Sympathetic sterile effusions may occur in joints adjacent to areas of cellulitis, and may be confused with septic arthritis. When cellulitis occurs over a joint local pain may cause guarding and apparent decreased range of motion of the joint. H. influenzae cellulitis is usually accompanied by fever and often has a characteristic purple color. Bacterial diagnosis should be attempted through needle aspiration at the border of suspicious lesions.

Cellulitis was diagnosed in 10 patients, 4.0% of the study population. Ages ranged from 0.9 to 13.2 years old; and there was a 2.3:1 male predominance. Pain was a common, but not invariable presenting symptom (60%) but swelling was mentioned by 90%. Duration of symptoms was less than three days in every case, with a mean of 1.4 days. 70% had antecedent trauma, 40% trauma with penetration and an obvious wound. The mean temperature for the ten children was 38.3°C; and 80% had fevers $\geq$ 38°C.

Erythema and swelling were the most prominent physical findings, each present in 80% of patients. Four children had clinically or radiographically evident joint effusions, but none had positive joint fluid cultures.

Erythrocyte sedimentation rates were $\geq$ 20 mm/hr in every case, but $\geq$ 40 in only 40%. White blood counts, however, were $\geq$ 15,000 WBC/mm^3 in only one child. Bacterial diagnosis was made in every child whose lesion was aspirated: three grew S. aureus and one group A beta hemolytic streptococci. Blood cultures were all negative.

Not included in this group with cellulitis is one 4.4 year old child who had a bacteremia, septic arthritis, and cellulitis all due to H. influenzae.

Viral Arthritis

Although several reviews and sporadic case reports of viral arthritis have appeared in the literature over the last ten years, not much recent research has been focused specifically on this topic (82, 84). Rubella, mumps, hepatitis, and a number of the arboviruses have been unequivocally implicated as the etiology of arthritis in some patients, while smallpox, vaccinia, varicella, rubeola and echovirus have been presumed but not proven to be the cause of joint symptoms in others (84). Adenovirus has also been associated with a case of acute arthritis (81).

The paucity of investigative research may be due to the relative lack of morbidity in patients with viral arthritis. Most have a benign, self-limited illness that leaves no residual deformity. While actual documentation of viral elements in synovial fluid is infrequently sought, a viral etiology for joint symptoms is not uncommonly invoked. Five children in our population were diagnosed as having viral arthralgia or arthritis. All had had recent upper respiratory or gastrointestinal illnesses, and four of the five were febrile, but in none was any substantiation of the viral etiology sought. A sixth child had a migratory polyarthritis two weeks after parotitis due to presumed mumps infection. Her amylase was 540 mg/100 ml at the time she presented with joint pain.

These children do not differ significantly from many of those included in the unknown etiology category. How many of the children

in our group actually had viral induced joint pain cannot be determined; but the hypothesis of a viral etiology for many children with mild, self-limited arthritis or arthralgia is attractive and deserves more investigation. Some viruses have documented associations with articular disease. Rubella arthritis is a common component of rubella illness in postpubertal females; and the virus has been isolated from the joint fluid of a child as young as fourteen months old (82). The typical syndrome presents with a symmetric polyarthritis which follows the appearance of the rubella rash by one to three days. Nearly all patients have pain and/or slight swelling of the hands and fingers. Knees, wrists, and ankles are commonly also involved. The joint symptoms usually resolve in one to two weeks, although they may continue for one to two months. Laboratory tests show normal to depressed white blood counts and normal or moderately elevated erythrocyte sedimentation rates. Joint destruction does not occur.

A similar clinical picture is sometimes seen in women several weeks after receiving rubella vaccination. This syndrome is rare in recently innoculated children, and usually resolves within several weeks.

Mumps arthritis has been described as a rare complication of that illness, and while it may occur in children, it is most common in young adults. Males are affected five times as frequently as females (84). It usually follows parotitis by one to three weeks, is self-limited, polyarticular, and occasionally migratory (78).

Patients with arthritis associated with viral hepatitis nearly always have the "hepatitis-associated antigen" present in their serum during the acute illness. Joint symptoms may precede clinical appearance of jaundice by one to two weeks. The syndrome is characterized by a symmetric polyarthritis which affects the hands and P.I.P. joints in 90% of patients, by morning stiffness, and frequently by the concurrence of an urticarial rash. Joint symptoms usually resolve within three to four weeks (84).

Varicella has been reported as a probable cause of a sterile joint effusion in a five year old girl (83). That child had a varicella rash, a painful, swollen knee, normal ESR, and normal white blood count. Joint aspiration revealed 3,800 WBC/mm^3 with 93% mononuclear cells. The symptoms, which resolved in four days, were attributed to her underlying infection.

Adenovirus infection, documented with a rise in serum antibodies to type 7 adenovirus, has been invoked as the probable cause of polyarticular arthritis in a nineteen year old man with an upper respiratory infection (81).

The other non-bacterial organism which is thought to cause arthritis is Mycoplasma pneumoniae. While mycoplasma infection is frequently associated with non-specific myalgias and arthralgias, the reported incidence of true mycoplasma arthritis, with joint swelling or severe pain, is low. When it does occur mycoplasma induced arthritis is usually migratory and polyarticular,and involves knees, ankles and shoulders more frequently than wrists or fingers (80).

There was one six year old white male in our study who presented with a three day history of upper respiratory infection, and swelling of his ankles, wrists, and hands. He was febrile, had an urticarial rash, decreased range of motion of his right wrist and swelling of both hands. Serologic studies showed an elevated titer against *Mycoplasma pneumoniae*.

Reactive Arthritis

Two children in the study had symptoms attributed to Salmonella infections. A six year old white boy presented three weeks after a bout of diarrhea with a six day history of a swollen left knee and a temperature of 38.9°C. An effusion of the knee was aspirated and revealed clear, sterile fluid. His white blood count was 11,000 WBC/mm^3 with no shift and ESR was 43 mm/hr. Salmonella was grown from blood and stool specimens.

The second child was a 10.8 year old white girl who had a seven day history of left hip pain, and gastroenteritis with diarrhea. She had a fever of 38.9°C and pain with movement of her left hip. Rectal swab grew Salmonella.

Arthritis is a well recognized rare complication of Salmonella infection and is estimated to occur in about 2.4% of patients with all types of Salmonella infections (86). Although some patients develop pyogenic arthritis, the children in our study fit the description of the "reactive arthritis" associated with Yersinia enterocolitica, Shigella, and Entamoeba histolytica organisms as well as with Salmonella. This reactive arthritis follows gastrointestinal symptoms by days to months, may be accompanied by fever, and usually involves one or several large joints. It is self-limited and non-deforming. White blood counts and ESR's may be normal or elevated.

Malignancies

Malignancies are an important, if not predominant, part of the differential diagnosis of arthralgia and arthritis in childhood. Acute lymphocytic leukemia is the most common malignancy in childhood, and the one which most commonly presents with joint pain and/or swelling (88). Neuroblastoma histiocytosis, lymphoma, Hodgkin's disease, reticulum cell sarcoma, rhabdomyosarcoma, osteogenic sarcoma, and bony metastases from these and other malignancies can also present with joint or limb symptoms.

The musculoskeletal manifestations of acute lymphocytic leukemia (ALL) may be difficult to differentiate from the symptoms of juvenile rheumatoid arthritis or of some of the non-specific causes of joint pain in children. Onset of symptoms may be sudden or gradual and may be present when the peripheral blood smear and bone marrow aspiration are normal or non-diagnostically altered from normal. The musculoskeletal symptoms of ALL are often severe diffuse or localized bone pain, but sometimes children exhibit an actual arthritis with joint pain, warmth, decreased range of motion, and joint effusions and swelling. The arthritis may be of one or more joints, and may have a fleeting, migratory nature. Positive tests for rheumatoid factor and subcutaneous nodules have been described (88). Radiographs are often negative when the child first presents, but they may show a thin, translucent juxtametaphyseal line, periosteal elevation or osteolytic lesions.

Fever, lymphadenopathy, hepatosplenomegaly and anemia may all be found in both ALL and JRA. The clues that the process is a malignancy are often evident in the peripheral blood smear. Profound anemia is not common in JRA, and thrombocytopenia and abnormal leukocyte forms are not associated with that disease. The pain associated with arthritis of ALL may provide a further diagnostic clue. It has been described as severe, and seemingly out of proportion to the degree of evident joint disease.

There were two children in our review with malignancies. One was a 4.8 year old girl who was evaluated in Maine for a limp and a warm, firm mass behind her right knee. X-rays revealed a lytic, blastic lesion and she was transferred to Yale-New Haven Hospital where excisional biopsy revealed osteogenic sarcoma.

The second child was a 2.3 year old boy who had had neutropenia documented three months prior with a total granulocyte count of 360 WBC/mm^3. The bone marrow showed decreased myeloid elements, but no diagnosis was confirmed. He presented this time with a two day history of pain in his ankles and wrists, and fever to 40°C. Physical examination revealed lymphadenopathy, splenomegaly and red, warm, swollen ankles. X-rays were negative, and it was not until two months later that blasts were identified in the bone marrow and a diagnosis of ALL could be made.

While malignancies are not common causes of joint symptoms in children they need to be ruled out in any evaluation of arthritis or

arthralgia since the consequences of delaying diagnosis of a malignant process may be severe.

Osteochondroses

The osteochondroses are a group of diseases which claim similarity in that they result in an avascular necrosis of bone. Although they are more frequently present in alcoholics, patients with systemic lupus erythematosus, sickle cell anemia or those on systemic cortico-steroid therapy, these diseases are not uncommon and are often the cause of joint pain in normal children and adolescents. The relative etiologic roles of trauma, endogenous stress which cause compression of ossific centers, endocrinologic abnormalities and local vascular disturbances are not clearly understood, and are probably not the same in each patient.

The unifying pathologic finding is necrosis of bone. In the early stages of disease, affected blood vessels are surrounded by edematous soft tissues, blood flow is compromised and cell death ensues. Although extensive necrosis of bone may occur, superficial cartilage often survives through nourishment provided by the synovial fluid. A period of repair may last from several months to five or six years. Capillaries enter the necrotic area from the periphery, there is a resorption of affected bone, and slow replacement with a normal bony architecture. If cartilage has been lost, it is replaced by fibrocartilage. Because integrity of the calcifying matrix is diminished during this stage of regrowth, the bone is especially vulnerable to even usual stresses. These may lead to a distortion of the healing bone and permanent funtional derangement.

Avascular necroses may occur in nearly any bone in the body, and in more than one site in one patient. The most common of the conditions classified as osteochondroses are Legg-Calve-Perthes disease and Osgood-Schlatter disease; both were found among the diagnoses in this review.

Legg-Calve-Perthes disease, also known as Legg-Perthes, Perthes disease, coxa plana and osteochondritis deformans coxae juvenilis, involves an avascular necrosis of the capital femoral epiphysis. Although much debated, the etiology has never been well demonstrated. Endocrine imbalances, structural abnormalities, exogenous and endogenous stresses have been implicated, but never proven. The condition is estimated to occur in about 0.1% of all males and in 0.02% of all females: a male to female ratio of about 5:1 (96). It is most commonly seen in children between four and eight years old, and only rarely in those under three or over ten years old. Although the children affected are usually healthy, many exhibit retarded bone maturation. Bilateral involvement occurs in approximately 10% of cases and black children are only rarely affected.

The pathologic process in Perthes disease is self-limited and normally runs a two to five year course, but if unrecognized and untreated may lead to premature closure of the capital femoral epiphysis, flattening of the femoral head, decreased range of motion at the hip and permanent disability. Prognosis is related to amount of epiphyseal involvement.

Perthes disease has a varied presentation. It should be considered in a child who complains of limp with or without pain in the groin, thigh or knee. Typically the pain increases with activity and decreases with rest. Physical examination may be normal or may reveal only slight tenderness over the hip with some limitation of abduction and internal rotation. More advanced cases may show marked loss of motion, atrophy of buttock and thigh muscles, muscle spasm and rarely flexion contracture at the hip. Symptoms are often vague and intermittent and may be present for days to months before medical advice is sought.

Diagnosis of Legg-Perthes is confirmed by x-ray examination. Widening of the joint space, represented on films by increased distance between acetabulum and femoral head as compared with the unaffected hip, is one of the earliest changes and is secondary to edema and inflammation. The appearance of cystic, decalcified areas heralds metaphyseal involvement. Lucent or dense lesions may be seen at the epiphysis, and the epiphyseal line may appear widened. Residual deformity is evident on radiographs as widening and shortening of the femoral head. Clinical symptoms may lag behind radiographic changes, as the disease may be clearly evident on x-rays by the time symptoms begin.

Our study included one diagnosed case of Legg-Perthes in a seven year old boy. He presented with a four week history of pain involving his right thigh and knee and with a negative history of

trauma. Physical examination revealed decreased abduction and rotation at the hip, with some pain on range of motion. White blood count and erythrocyte sedimentation rate were normal. The diagnosis was suggested by the x-ray findings of ephyseal fragmentation and lucency. Bone scan revealed decreased uptake in the region of the right femoral head and arthrogram was also consistent with Legg-Perthes. Unfortunately, despite prompt therapy this boy did develop some flattening of his femoral head.

Osgood-Schlatter's disease involves the site of attachment of the patellar tendon to the tibial tubercle. Although the widely accepted theory is that this disease represents avascular necrosis of the tibial tubercle, some maintain that the inflammation and pain at that site is caused by an avulsion fracture of the tubercle (7). The disease frequently presents after a period of rapid growth which may lead to a temporary imbalance in the relative lengths of proximal tibia and patellar tendon and abnormal stress at the point of tendon insertion. Direct trauma has also been implicated as a cause of inflammation and avascular necrosis. The disease is more benign than Legg-Perthes. Lesions usually heal in two to three years without residual functional deformity and therapy is often limited to self-moderation of activity.

Osgood-Schlatter's disease is most common in children from ten to sixteen years old and, as mentioned above, often follows a period of rapid growth. Boys are affected slightly more often than girls. Involvement is bilateral in approximately 30% of cases.

Symptoms may develop insidiously over days to months, or have an abrupt onset with or without a history of trauma. Pain is usually most intense following exercise requiring quadriceps contraction, and is least intense or absent following periods of diminished activity or rest. Discomfort is usually localized to the region of the tibial tubercle, but may be present along the entire course of the patellar tendon.

Physical findings include tenderness at the site of insertion of the patellar tendon to bone. Soft tissue swelling may be absent, localized to the region of the tibial tubercle, or extend proximally along the patellar tendon. The tubercle may appear and feel swollen, bulky,or firm and enlarged.

The x-ray findings in Osgood-Schlatter's disease include irregular ossification and fragmentation of the tibial tubercle with swelling of the patellar tendon at its point of insertion. Ossification of the tibial tubercle takes place during the eleventh to fifteenth years and Osgood-Schlatter's disease should not be diagnosed solely on the basis of irregular ossification of the tubercle on x-ray, since this is a normal finding during adolescence.

Osgood-Schlatter's was diagnosed in ten patients in the group reviewed. There were nine males and one female from 11.3 to 15.9 years old, with a mean age of 13.5 years old. At the time of presentation four complained of unilateral involvement and six of bilateral involvement; however, eight patients eventually developed

bilateral disease. Nine of ten complained of pain, only two patients complained of swelling. Duration of symptoms ranged from eight hours to two years, but 70% had complaints for less than one month. Only two patients gave a history of direct trauma to the knee region, while two others reported onset of symptoms following basketball games.

Physical examination revealed localized tenderness of the involved tibial tubercles in every patient and swelling in one half the patients. An effusion of the adjacent knee joint was noted in one case, and in another swelling was noted to extend along the tendon from the tibial tubercle to patella. X-rays were taken in five patients, three of these revealed irregularities of the painful tibial tubercles. While most patients did well on regimens of rest and decreased activity, one patient required a cylinder cast for adequate control of pain and swelling.

Osgood-Schlatter's disease is relatively benign and the diagnosis can often be made on the basis of history and physical findings alone. This should not preclude investigation of other possible sources of knee pain. A serious disorder of the hip may be missed if knee pain is attributed to pathology of the tibial tubercle and the patient is lost to follow-up.

Kohler's disease is a condition characterized by aseptic necrosis of the tarsal navicular. It is less common than Osgood-Schlatter's and usually occurs in children between three and ten

years old. The patient presents with a limp, pain over the region of the navicular, and discomfort which persists at rest. In more advanced cases moderate to severe pain may occur with swelling and localized tenderness. Symptoms worsen with activity, tend to be constant rather than intermittent, and may lead to refusal to bear weight. Diagnosis is confirmed by an x-ray examination which reveals increased density of the tarsal navicular and areas of lucency or fragmentation. Care must be taken in interpreting films of three to six year olds since ossification of the navicular normally takes place during this period and overlapping areas of ossification may appear on x-ray as an irregular area of increased density. Misdiagnosis and lack of non-weight bearing therapy may result in permanent compression of the navicular bone. Case #246 was a five year old boy who presented with foot pain and swelling of only one day's duration. He had no history of direct trauma to the foot, but had played football one day prior. He refused to bear weight on the affected foot and was found to have a tender, swollen foot. X-rays showed soft-tissue swelling, as well as irregularity and sclerosis of the navicular. He was treated with a non-weight bearing protective cast and did well. Follow-up x-rays revealed new bone formation.

Osteochondritis Dissecans

Osteochondritis dissecans is a disease caused by complete or partial detachment of cartilage and subchondral bone from a joint surface. The knee is the most common site affected, but the process may occur at the hip, ankle or elbow as well.

The etiology of this condition is not fully understood, but is thought to be initiated by infarction of bone secondary to vascular disturbances or trauma. This leads to necrosis of bone but not necessarily of the overlying cartilage since cartilage may survive through nourishment provided by the surrounding synovial fluid. Because its support is weakened the fragment of cartilage and subchondral bone separates partially or completely from the joint surface and becomes a mechanical impediment and a source of joint pain. The process may be compared to the lifting of a piece of sod from a lawn. If unremoved the section of grass and underlying dirt disturb the smooth contour of the lawn.

Osteochondritis Dissecans of the knee affects the medial condyle of the femur in about 85% and the lateral condyle of the femur in 15% of cases. The site of detachment most commonly involves a portion of the intercondylar notch but may be located anteriorly or infero-centrally on one of the condyles. In 25-30% of cases the disease is bilateral; and involvement of all four femoral condyles has been reported. Rarely the patella is affected.

The role of trauma in the etiology of osteochondritis dessicans is perhaps more important than in the other osteochondroses. One study showed that among one hundred patients with osteochondritis dessicans of the knee 46% had a history of significant trauma, and 78% were regular participants in active sports (89). Although none of the four patients with the disease in our group had a history of trauma, one had played baseball, and one football within twenty-four hours of the onset of symptoms.

There is about a 2:1 predominance of males to females with this disease and although it may present in any school aged child it is most common in teenagers. The typical history is one of intermittent, recurring pain with vague symptoms of clicking, giving way, and occasional swelling. Physical examination may show an effusion as well as swelling at the knee. Quadriceps atrophy may be present. Locking or decreased range of motion of the knee may be present when the detached cartilage has become a mechanical impediment.

When osteochondritis dessicans is being considered x-rays should be taken in anteroposterior and lateral positions as well as posteroanteriorly with the knee flexed at 30°: "tunnel view". Positive findings include a fragment in the joint space, a saucer-shaped defect, or a radiolucent line defining a fragment still attached to the affected bone. Detachment is rare in children less than ten years old. Free cartilaginous fragments may actual proliferate in the nourishing environment of the synovial fluid, and develop areas of ossification which are visible on x-rays.

Therapy of osteochondritis dessicans often involves surgery, but more patients are now being managed with immobilization in a non-weight bearing splint or brace for four to six months.

Slipped Capital Femoral Epiphysis

Slipped capital femoral epiphysis can best be described as a change in orientation of the capital femoral epiphysis to the femoral neck. The most common misalignment involves a displacement of the femoral head posteriorly and downward with an anterior and upward movement of the femoral neck, however other changes are possible. The condition is graded as minimal or slight if migration of the femoral head is less than one centimeter; as moderate if it is greater than one cm, but less than one half to two thirds the diameter of the femoral neck; and as severe if migration is greater than one half to two thirds the diameter of the femoral neck. A "pre-slip" is recognized if x-rays show widening and rarefaction of the epiphyseal plate without any apparent migration of the femoral head.

Slipped capital femoral epiphysis is usually recognized in adolescents following a period of rapid skeletal growth. Although the condition has been reported in children as young as six years and as old as seventeen, the peak age is eleven for girls and fourteen for boys. This reflects the earlier skeletal maturation of females as opposed to males. There is a five to one male to female predominence. In 20-25% of cases symptoms are bilateral, but up to 40% may show bilateral x-ray abnormalities of the capital epiphysis.

Slipped capital femoral epiphysis appears most commonly in children with one of two distinct body builds. The condition is most common in boys who are obese, with a female distribution of fat and underdeveloped genitalia. A smaller percentage with the disease are tall and thin and

have just finished a period of maximal skeletal growth. The frequency of association of these two types with slipping of the femoral neck has led many to hypothesize an underlying endocrinologic etiology. Growth hormone from the anterior pituitary stimulates the proliferation of cartilage cells at epiphyseal plates, thereby increasing the thickness of the plates and making them more vulnerable to shearing stresses. Testosterone and estrogen indirectly depress proliferation of cartilage cells and promote closure of epiphyseal plates, which leads to greater resistence to shearing stresses. The obese, underdeveloped child may have a relative lack of sex hormones, while the tall, thin child may have an increase in circulating growth hormone. Both these hormonal conditions might result in decreased resistence of the epiphyses to shearing stresses. The fact that the pathologic condition is seen at the hips is probably related to the greater stresses the capital femoral epiphyses are subjected to through their role in weight bearing.

Other theories relate slipping to traumatic events, although only about 25% of patients give a history of trauma. When symptoms appear acutely however, 40-50% will report antecedent trauma. Some believe that the normal change of the epiphyseal plate from a horizontal to an oblique orientation during adolescence decreases the resistence to shearing stresses. During adolescence the periosteum surrounding femoral head and neck becomes thinner and this may also play a role in weakening the region of the epiphyseal plate (98).

Clinical manifestation of a slipped capital femoral epiphysis may be present for days to months before medical attention is sought. Pain is an almost invariable symptom and while it may be present in the hip or groin, approximately 50% of patients will localize pain to the thigh or knee. For this reason many cases are misdiagnosed. Because Osgood-Schlatter disease is common in rapidly growing adolescents, knee pain is often attributed to this disease. The two conditions may exist simultaneously and hips of children with knee pain should be examined. Physical findings of slipped capital femoral epiphysis may include a limp, decreased flexion, abduction and internal rotation of the hip. A common finding is active external rotation of the thigh when the hip is passively flexed.

X-rays of both hips should be obtained when a slip is suspected. Early changes include a widened epiphyseal line with adjacent areas of irregular demineralization. Antero-posterior views will best show medial slips, and lateral views reveal posterior slips. Frog leg views may also be helpful.

The diagnosis of slipped capital femoral epiphysis should not be delayed or treated lightly. Minor trauma may convert a slight, easily treated slip into a severe slip which may be difficult to correct.

There was one case of a slipped capital femoral epiphysis in the study population. He was a 15.9 year old white male who presented with a five month history of right hip pain and a limp which followed a

trampoline injury. Physical examination revealed decreased range of motion of the right hip, and the diagnosis was established by x-ray examination. He was treated with traction and corrective surgery, and did well.

Other Disorders of the Knee

The knee is the most common site of joint pain in children and the most common site of joint pain of unknown etiology in this review. For this reason, the differential diagnosis of non-infectious, non-inflammatory knee abnormalities will be discussed in a bit more detail.

Discoid meniscus is a congenital malformation, which most commonly affects the lateral menisci. Normally both the medial and lateral menisci are semilunar structures, which attach anteriorly and posteriorly to the intercondylar ridge of the proximal femur. When the meniscus is discoid rather than semilunar it lacks the posterior attachment to the tibia. Instead, a short ligament, the ligament of Wrisberg, forms the sole attachment of the posterior portion of the lateral meniscus to the lateral face of the medial condyle. When the leg is extended, this ligament restricts forward motion of the meniscus and pulls it into the intercondylar area. The condition rarely causes problems in young children, but by age six to eight the constant abnormal movement of the meniscus has caused it to become irritated and secondarily thickened, fibrous and enlarged. The mechanical impediment causes symptoms of snapping, clicking and "giving way", but only rarely causes pain. The classical finding is a palpable and sometimes audible "clunk" as the knee is moved from flexion to extension. Treatment is surgical removal of the affected meniscus.

Sinding-Larsen, or Larsen-Johansson disease is a condition characterized by pain and swelling of the knee which is localized to the site of origin of the patellar tendon at the patella. The disease is usually bilateral, affects males predominately, and has a peak incidence in boys between seven and fourteen years old. Pain characteristically increases with activity and subsides after periods of rest. The abnormality is thought to be due to osteochondritis of an accessory ossification center of the patella. Radiographs show swelling of the soft tissues and irregualr ossification at the proximal pole of the patella. X-rays of normal children often show their two patellas to be of differing dimensions and densities; so care must be taken in interpreting films. The disease resolves spontaneously by age thirteen to fifteen with fusion of the accessory ossification center.

Malalignment of the patella, chondromalacia patella syndrome and recurrent dislocation of the patella represent a spectrum of disorders which derive from abnormalities in the position of and forces on the patella. These conditions are a common source of knee pain in children and are more common in girls than in boys. They may have an increased familial incidence, and often present following trauma or a period of rapid growth. The understanding of these abnormalities requires a knowledge of normal patellar mechanics.

The patella is a large sesamoid bone which develops in the tendon of the quadriceps femoris muscle. Ossification progresses irregularly during childhood from several ossification centers in

varying positions. Radiographs of normal developing patellas may reveal granular borders and spotty areas of mineralization. Because of these normal irregularities, pathologic changes are often difficult to recognize on x-rays. The patella, when situated correctly within the quadriceps tendon, rides smoothly over the groove between femoral condyles during active flexion and extension of the knee. Normal pull of the quadriceps mechanism is directed in a relatively straight line between anterior superior iliac crest and tibial tubercle. The patella is held in position by the lateral hindrance of the lateral femoral condyle and the medial forces of the strong joint capsule and the vastus medialis ligament.

Patellar position can be measured as the "Q" angle. This is defined as the angle formed by intersection of a line from anterior superior iliac crest to the tibial tubercle and a line through the center of the patella to the tibial tubercle. An angle of greater than twenty degrees is considered abnormal and predisposes the patient to patellar irritation (94). The increased angle may be secondary to a variety of causes. Underdevelopment of the lateral condyle of the femur, weakness of the medial portion of the quadriceps mechanism, external tibial torsion, genu valgum, a high-riding patella or trauma may change the normal forces on the patella and allow it to move laterally. In this position, the patella takes an abnormal tract in its movement over the underlying structures and consequently may become a source of irritation, inflammation and knee pain.

Patellar irritation causes intermittent, diffuse, aching pain along the anteromedial portion of the knee, exacerbated by activities which require active quadriceps contraction such as hiking, or stair-climbing, and relieved by rest. The "movie sign" is so named because patients complain of discomfort following prolonged sitting with flexed knees. Often an episode of trauma will initiate a course of vague knee pain and discomfort. Swelling may or may not be present. Some patients report occasional "giving way" and a locking or grating sensation with knee motion.

Physical examination elicits tenderness localized to the medial side of the joint which may be confused with the tenderness of a meniscal tear. Tenderness may also be elicited by applying direct pressure to the patella thereby causing contact between irritated patella and the femoral groove. Some patients will be unable to tighten their quadriceps muscles when pressure is applied to the patella. This is due to the pain caused by patellofemoral contact as the patella is pulled upwards by the quadriceps mechanism. These maneuvers should be performed with the knee in slight flexion in order to avoid trapping synovial tissue in the intrapatellar pouch which can be quite painful in normal knees.

Although the chondromalacia patella syndrome is diagnosed by some when the findings mentioned above are present, others reserve this diagnosis for knees in which chronic irritation has led to demonstrate swelling, fibrillation or erosion of the articular

cartilage of the knee. Treatment consists of correction of the malalignment of the patella. Early cases are often correctable by exercises which strengthen the medial forces of the quadriceps. When pathologic changes in the cartilage are clearly demonstrable surgery may be required.

Recurrent dislocation of the patella is relatively uncommon, but is seen most frequently in tall, long-legged adolescent girls. In this condition, forces that allow lateral displacement of the patella are exaggerated to the point that the patella is intermittently pushed around the outside of the lateral condyle of the femur. Usually the patient will present after or between episodes of dislocation. Pain, swelling or effusion may be noted. Extreme apprehension when lateral dislocation is attempted is often a good clue to the etiology of the knee symptoms. X-rays may show the dislocation on A-P view. The lateral view may show a high-riding patella that has escaped the normal buttressing forces of the lateral femoral condyle.

Specific mechanical disorders of the knee, other than Osgood-Schlatter's disease and osteochondritis dissecans, were diagnosed in only two children in this review although there were thirty children with knee pain of unknown etiology. One 11.5 year old boy with a two-day history of knee pain was diagnosed at a follow-up visit as having a subluxed patella. A 3.8 year old boy who had had one year of intermittent knee pain was described as having lax knee ligaments.

Trauma

Fractures, ligamentous and muscular injuries are common in normally active children and should be at the top of a differential diagnosis of a child presenting with joint pain. Evaluation of traumatic injuries should be done with an open mind, however, for the underlying disease may have been caused by the trauma or merely heralded by it. A chronic, intermittent, or mild symptom may be made acute and severe by a blow to the affected area, or an injury to a distant site may bring attention to a previously ignored discomfort.

Conversely, traumatic injuries may be present despite a negative history for falls, blows, or other accidental or non-accidental injuries. Poor histories may exist for a variety of reasons. 1) The child may be too young to talk and witnesses may not have been present. 2) The injury may have gone unnoticed. This is especially true for injuries incurred during athletics or active play which only present hours to days later with unexplained pain and/or swelling of the affected site. 3) The child may have a diminished sense of pain for neurologic reasons, and even severe injuries may be unrecognized. 4) Child or parent may be reluctant to reveal the source of the injury. If the child was involved in some prohibited activity at the time of the accident he or she may deny it, or fabricate a story to explain the injuries. Not dissimilarly, parents may deny trauma or fabricate a story to cover up neglect or battering of the child by themselves or other adults.

The diagnosis of traumatic injury or probable traumatic injury was made in eighteen patients, 7.2% of the review group even though children with an obvious history of trauma were excluded from the review. 61% were male, 39% female, and there was a significantly increased incidence of traumatic diagnoses in the spring months (P = 0.005). Pain was the presenting symptom in 78% of cases, one third were unable to walk when they came to the hospital.

44% of those children with assumed traumatic problems had no history of trauma. Two of these children had evidence of otitis, a third had had an earache one week prior. It could be questioned if the joint pain in these children was related to an underlying illness rather than to trauma. All three had pain in a single knee.

Hemoglobin levels and white blood counts of children in the "traumatic" category were all within normal ranges with the exception of one child with sickle cell trait who was slightly anemic. Several children had elevated erythrocyte sedimentation rates although the mean ESR for this group was 16.4 mm/hr. One child with concurrent otitis media had a value of 48 mm/hr and two children with open, infected wounds had values of 28 and 33 mm/hr. X-rays in this group were non-diagnostic in every instance. 69% had negative films, 31% showed non-specific changes.

The two children in the study with fractures were included, somewhat arbitrarily, in the "orthopedic" rather than the "traumatic" category. One had a non-union of an old, undiagnosed fracture. The

second was a child with multiple neurologic anomalies who was found to have a fracture of her distal tibia with no traumatic history. Most childhood fractures present acutely with a clear history of injury to the affected site and present little diagnostic dilemna.

Transient Synovitis of the Hip

5% of our population, and 28% of those who presented with complaints referrable to hips only, were diagnosed as suffering from transient synovitis of the hip. This disease, of questioned etiology, is known also as irritable hip, transitory coxitis, acute transient epiphysitis, and observation hip. It has been reported to be the most common cause of hip pain in children, and was the most common cause of pain limited to the hips in this study (100). The name, observation hip, derives from the usual approach to therapy - rest, analgesia, and in severe cases, traction on the affected leg.

Our patients closely fit the clinical description of the syndrome. Children are usually less than ten years old and present with a history of hip pain with or without referred pain to the thigh or knee. Onset may be acute or insidious. In our group of fourteen patients ages ranged from 2.5 to 8.9 years with a mean of 5.5 years. The chief complaint in every case included hip pain, and two children also had pain in the groin area. While seven children presented with a limp (50%), two of the children under three years old were irritable and refused to stand. These two children held their affected limbs in abduction, flexion, and external rotation, consistent with spasm of hip flexor and abductor muscles.

Duration of symptoms ranged from less than six hours to one week, with a mean of 1.7 days. Boys are classically affected more commonly than girls, and in this series the male to female ratio was 6:1.

Two patients reported trauma: one related to a fall twenty-four hours prior to onset of hip pain, the other related to a foot wound incurred five weeks before symptoms began. Two patients had histories of recent upper respiratory tract infections, and two had histories of allergies. The roles of trauma, viral illness, and allergy in the etiology of this disease have all been investigated with consistently negative results (100).

Laboratory studies in transient synovitis of the hip are non-diagnostic. Erythrocyte sedimentation rates may be normal or slightly elevated. Our values ranged from 4 mm/hr to 46 mm/hr, and the mean was 20 mm/hr. White blood counts may also be normal or slightly elevated. The mean in our series was 10,500 WBC/mm^3, with the highest value being 14,200 mm/hr. Low grade fevers are occasionally present. Among our patients four children had temperatures greater than 37.5°C and two had values greater than 38°C.

Results of joint, blood, and urine cultures in our group, and as reported in the literature, were negative. X-rays are usually negative but may show some widening of the joint space or increase of soft tissue shadows on close examination (99). One x-ray in our series showed a joint effusion.

Physical examination of our patients revealed pain on palpation in five patients, pain with passive range of motion in nine, and limitation of joint motion in five patients. No heat, erythema or joint swelling was noted.

Case #96 stood out as being slightly atypical. That child was female, had a temperature of 38.5°C, erythrocyte sedimentation rate of 46 mm/hr and white blood count of 14,200 WBC/mm^3. She did have a concurrent upper respiratory infection which could account for the more prominent laboratory results.

Despite its unknown etiology, transient synovitis of the hip is not an uncommon condition in childhood. It should be recognized and distinguished from other causes of hip, leg, or knee pain. Although it has a seemingly benign course, there is some evidence that this disease may predispose to future difficulties, such as osteoarthritis or Legg-Perthes' disease of the affected hip (101).

Discitis

Discitis or "intervertebral disc-space infection" is a disease of unknown etiology which is often not considered in the differential diagnosis of children with back, hip or abdominal pain. Originally described as a benign form of osteomyelitis of the spine, this lesion affects the intervertebral discs and causes a variety of clinical presentations.

Although discitis may affect children of any age, it is rarely present in persons over thiry years old, and in one pediatric series over 50% of patients had onset between one and four years old (105). Some children will present with a one to four week history of vague back pain which sometimes causes a limp and occasionally leads to intolerance of any upright position. These children want to lie in bed and they resist any motion of thigh or pelvis. Other children may complain of diffuse pain which radiates to anterior or lateral thigh. The "irritable child" is a common presentation. When inflammation around the disc extends to the surrounding meninges, the presentation may mimic meningitis with a positive Kernig or Brudzinski test, hyprereflexia, and clonus. Lumbar puncture should be normal. Finally, involvement of upper lumbar discs sometimes produces a syndrome of abdominal pain, nausea, vomiting and rarely, ileus.

Some children may give histories of trauma or upper respiratory tract infection. Low grade fever is not uncommon and temperatures up to 39.2°C have been reported (105). Physical examination reveals an uncomfortable child with guarding and splinting of the back. An area of localized tenderness may be easily palpable, or may be

elicited by tapping the head or heels of a patient who is in the prone position. L4-L5 is the most common site of involvement.

Laboratory evaluations are of minimal diagnostic value. Erythrocyte sedimentation rates are greater than 20mm/hr in 80% of children, but may be normal. White blood counts are normal or elevated. Tuberculin skin testing should be negative. Cultures of material taken from needle aspiration of the involved disc space yield positive results in 25-50% of cases. Staphlococci are the predominent organism and 95% of positive cultures will grow either staphlococci or streptococci. Blood cultures are not uncommonly positive for staphlococci.

The diagnosis is confirmed by radiographic examination, but characteristic changes are not present for two to four weeks after the onset of symptoms. Disc space narrowing is the earliest radiographic change. Later, erosions may be visible in the vertebral end plates on either side of the affected disc. X-rays should be repeated after two to three weeks if the initial films are normal. Bone scanning may be helpful as increased uptake on either side of the affected disc may be present before x-ray changes are clear.

Etiologic theories involve hematogenous seeding of the intervetebral discs with infective organisms or embolic particles. The decreasing incidence of the disease could then be explained by the progressive decrease of vascularity of the intervertebral discs with

advancing age.

The primary therapy is immobilization. Although antibiotics are indicated in children with positive blood cultures or prolonged pain after immobilization, there seems to be no difference in the clinical course of children treated with and without antibiotic therapy.

Some children form spontaneous fusions of the involved vertebral bodies. Most recover completely but mild scoliosis and some recurrences have been reported.

There were no children in the study population with intervertebral disc space infection.

Lyme Arthritis

During the period of time reviewed in this study, 1972-1976, a new epidemic form of arthritis was recognized in three adjacent Connecticut communities: Lyme, Old Lyme, and East Haddam, and was studied by a group from Yale-New Haven Hospital (106). The disease was described in thirty-nine children and twelve adults and was characterized by asymmetric pain and/or swelling of one or more joints. While the duration of the initial illness was usually short, patients tended to have several recurrent episodes. An erythematous papule which expanded into a red annular lesion with central clearing and diameter up to 50 cm. preceeded the onset of arthritis in 25% of patients.

Some patients reported systemic symptoms such as malaise, headache, fever or nausea. Laboratory findings were not of diagnostic significance. ESR's ranged from 4-55 mm/hr. with a mean of 15 mm/hr. Four patients had postive tests for rheumatoid factors.

The epidemiologic clustering of this syndrome within three sparsely populated communities, and the clustering of affected patients along single roads or within families led to the question of an infectious etiology. However, residents within a single family or along a single road were not all affected and those who were did not have symptoms in the same year. Serologic testing for adenovirus, arbovirus, mumps, rubella, and other agents known to

cause arthritis yielded no suggestions as to etiology.

The facts that the patients lived in wooded, sparsely settled areas, that the disease had a peak incidence in the summer months, and that there was no evidence of airborne transmission has led the investigators to hypothesize transmission by an arthropod vector.

There were no patients in our study who clearly fit the clinical description of Lyme arthritis. The typical skin lesion was not described by history or physical examination in any of our patients. Table 1-1 shows the geographic distribution of the population studied. While there were no residents of Old Lyme, Lyme, or East Haddam included, one child was from Moodus, a small town a few miles north of East Haddam. That child was a ten month old girl who had a five-week history of rash, diarrhea, hepatosplenomegaly, fever and joint pain localized to hands and feet. She was anemic, had an ESR of 58 mm/hr. and was treated with intravenous antibiotics for salmonella enteritis, but continued to have fever and joint symptoms. She was diagnosed as having systemic juvenile rheumatoid arthritis and has remained symptomatic with multiple joint involvement for several years.

This patient does not fit the clinical picture of Lyme arthritis and therefore this study cannot be considered to have identified any new cases of the illness. With knowledge of the characteristics of Lyme arthritis in mind some children who will present with joint pain of unknown etiology in the future may be found to fit into that syndrome.

Limb Pains (Growing Pains)

Although only two children in this review 0.8% were diagnosed as having "growing" or "limb" pains, one study estimated the incidence in 2178 school children from six to nineteen years old to be 12.5% for boys and 18.4% in girls (109). Other estimates have ranged from 4.5% to 19.8% of normal children (107,108). It is possible that a number of children in the"unknown etiology" categories of this review would fit the clinical description of growing or limb pains.

Limb pains is actually the preferred name for this syndrome since no associations have been found between the occurrence of pains and periods of rapid growth. Furthermore, children with limb pains show no alterations in height or weight and no pain localized to the epiphyseal growth centers.

Limb pains have been described as non-articular pain in the extremities with no demonstrable organic basis (107). They are more common in children from six to thirteen years old but may begin in children as young as three years old. The pain is described as aching and heavy. It often is limited to thighs, shins, and calves but may also be present in the arms or trunk. Episodes of pain last from several minutes to several hours, are usually intermittent over months to years and are more common after strenuous exercise. Some children will complain of pain only in the evenings or night. The pain may be severe enough to wake them from sleep, but usually subsides within a few minutes. Nocturnal pain is usually localized to the legs.

Physical examination during or between painful episodes reveals no abnormalities and laboratory tests are usually normal. While pain is often localized to an extremity rather than to a specific joint children may complain of knee, ankle, back or elbow discomfort.

The etiology of limb pains remains unclear. As mentioned above, they are not related to growth. Psychogenic factors have often been implicated as a cause of limb pains and they do appear to have a role in some but not all cases. Limb pains are the second most common non-specific pain in childhood. Headaches are more common, with a reported incidence of 20.6% and abdominal pain slightly less common at 12.3%. 40% of children with limb pains also have headaches and/or abdominal pain (109). Apley has found that children with limb pains are more commonly anxious or emotionally disturbed than children without limb pains (107). He suggests that the diagnosis of psychogenic etiology be reserved for those cases where organic disease has been reasonably excluded and where there is positive evidence of emotional and/or family disturbances.

Other etiologies for limb pains have been proposed. An increased familial incidence of limb pains has been recognized and may represent psychologic or possibly genetic influences. Nutritional rickets may cause limb pains, and can be recognized on the basis of x-ray changes and elevated alkaline phosphatase. Some children with limb pains are found to have hypermobile knees and/or ankles. The roles of occult infections such as tuberculosis and brucellosis, and of a variety of

viral organisms have been questioned but not investigated. Although some adults have similar pains to childhood limb pains, follow-up studies have not been carried out in order to elucidate any connection between the childhood and adult syndromes.

Eight children in this study were diagnosed as having growing pains, psychogenic complaints, or as being "normal" children. All had normal joint examinations and negative x-rays. Two had recent or concurrent viral infections and complaints of only one or two days' duration: they may have had viral-related arthralgias.

Evaluating The Child With Arthritis or Arthralgia.

As can be appreciated by studying the differential diagnosis of arthritis and arthralgia in childhood, the evaluation of a child with joint pains is often a difficult task. The immediate goal of the physician should be the recognition of those children who have serious infections or potentially life-threatening conditions. Once those diseases have been ruled out specific diagnoses may be pursued through appropriate tests and follow-up examinations.

Acute rheumatic fever, osteomyelitis, septic arthritis, and malignancies together accounted for only 16% of the diagnoses in this study, yet because of their serious consequences they must be ruled out in any child who presents with joint complaints. Careful medical histories, physical examinations and appropriate laboratory tests should identify those children at most risk for these and other articular-related diseases. While each child with joint complaints will not require a complete medical evaluation the physician should be satisfied that enough questions have been asked and an adequately extensive physical examination has been performed to avoid missing a serious illness.

In an organized evaluation of children with joint complaints a detailed history is the first and often most important step. The first information obtained is the patient's age, sex, and race. Although no disease is unquestionably ruled out in any of these groups, children under three years old are unlikely to have acute rheumatic fever or

osteochondroses; children over eight to ten years old are less likely to have Henoch-Schonlein purpura or septic arthrits, and are more likely to have "orthopedic" disorders than younger children.

Towns of residence were not used as diagnostic parameters in the cases we reviewed; yet the clustering of patients with "Lyme arthritis" demonstrates that arthritis may occur as a local phenomenon and that a patient's "geographic" history may be important.

The exact extent of joint involvement should be questioned. Although many diseases may be either mono- or polyarticular, a division can be made between children with clearly monoarticular or clearly polyarticular involvement. Orthopedic disorders are usually limited to one particular joint even though they may be unilateral or bilateral. Cellulitis and osteomyelitis are usually, but not always, localized to one area. Transient synovitis of the hip, by definition, affects only the hips. Juvenile rheumatoid arthritis is divided into subgroups according to joint involvement. Acute rheumatic fever, allergic reactions, and many of the viral arthropathies are commonly polyarticular. It is important to specifically ask about secondary sites of joint involvement since severe symptoms in one joint may mask symptoms in another.

The presence and nature of articular pain may be an aid to diagnosis. Severe pain is unusual in rheumatic disorders and may be a clue to an underlying malignancy. Pain may be a minor or absent component of articular disease in children with allergic reactions. Morning stiffness and relief of pain with exercise is characteristic of many of the

rheumatic disorders, but the pain associated with orthopedic or traumatic conditions usually is aggravated by exercise and relieved by rest. It is important to remember that knee pain is a common symptom of pathology at the hip.

Polyarticular symptoms should be classified as migratory or non-migratory. Migratory pain is defined as pain which develops in one or several joints, and then resolves in those sites while simultaneously developing in another joint or joints. "Flitting" arthritis is a more descriptive term, and is characteristic for acute rheumatic fever and some of the viral arthropathies.

Joint swelling is best evaluated by physical examination, but it may only be present as part of the history. The exact location of the swelling should be elicited. Intermittent effusions of the knee are a symptom of many of the orthopedic disorders. Migratory joint swelling may be a component of JRA, acute rheumatic fever, or a viral-related disease. If joint swelling occurs as part of septic arthritis, osteomyelitis or cellulitis, it usually will not resolve spontaneously.

The constancy of joint pain and/or swelling is significant. Intermittent symptoms are characteristic of many orthopedic disorders, of psychogenic problems and of growing pains. Intermittency is not present in septic arthritis, osteomyelitis or cellulitis.

The duration of joint symptoms prior to presentation is of some aid in diagnosis. In our review children with allergic reactions, Henoch-Schonlein purpura, and cellulitis all had had symptoms for less

than a week. Children with symptoms for greater than one month may have had JRA, psychosocial problems, or orthopedic disorders, but did not have septic arthritis or osteomyelitis.

A history of previous or recurrent joint difficulties should be sought. One child in our study was seen in the emergency room for knee pain three times within two weeks by three different physicians. Each episode was treated as a primary visit and no diagnosis was ever made.

As has been discussed previously, trauma may be a cause of joint pathology, may aggravate joint pathology, or may be coincidental to it. A history of trauma should include a description of the event, its temporal relation to the presenting symptoms, and a description of the degree and kind of injury sustained. In our study, children with cellulitis, osteomyelitis, septic arthritis and traumatic injuries had the highest incidences of previous trauma, and those with JRA, acute rheumatic fever and Henoch-Schonlein purpura hte lowest.

A history of trauma which does not seem appropriate to the physical condition of the child may be a clue to child battering. A 1.4 year old girl in our study was brought to the hospital because of a limp of six months' duration. The history of trauma was only that she "might have fallen". She was febrile, had bilateral otitis media and radiographs revealed an old fracture of her left distal femoral epiphysis. Medical records showed that there was a history of child abuse in her family.

Rashes are best evaluated at physical examination, but they may have resolved by the time children present with joint complaints. A

detailed description of the onset, progression, character and pattern of any skin lesions may aid in diagnosis. If a rash is present at presentation, it is important to know whether it is an acute or chronic phenomenon, whether it itches, whether it changes in pattern over the course of a day, and whether it has been present previously.

If a fever is present or has been present a characterization of its height, periodicity, and duration is helpful. High, spiking, unremitting fevers are characteristic of bacterial infections, although not all children with bacterial interactions are febrile. 70% of the children in this study with osteomyelitis, 80% with cellulitis, 100% with septic arthritis, and 70% with other bacterial infections were febrile. 100% with systemic onset JRA had fevers $\geq$ 38°C. The classic fever of JRA is characterized by one or two high diurnal swings with return to normal or subnormal values between peaks. Fever is a minor manifestation of acute rheumatic fever and was present in 75% of our patients with that illness. There is no characteristic fever pattern for acute rheumatic fever, in fact, the fever, if present, may be high and unremitting, may have diurnal variations which resemble the fever of JRA, or may be low grade.

The outpatient physician may decide to limit a systems review in an obviously well child with no extra-articular complaints, but a child with joint symptoms and rash or fever, or a child admitted to the hospital for evaluation needs more extensive questioning.

Family history should include not only notation of relatives with rheumatoid arthritis or rheumatic diseases, but also, whenever possible,

the familial incidence of ankylosing spondylitis, inflammatory bowel disease, psoriasis, metabolic diseases, hematologic abnormalities orthopedic disorders and non-specific joint pains.

Congenital neurologic, cardiac, skeletal, and other anomalies may predispose to joint complaints later in life. Specifically, decreased perception of pain, previous orthopedic surgery and heart murmurs are significant past history. Sickle cell anemia, thalassemia, and hemophilia may all lead to joint pathology.

Severe nutritional deprivation causing rickets or scurvy is an extremely uncommon cause of joints symptoms, but when appropriate a nutritional history may be sought.

Sore throat, rhinitis, cough, wheezing, ear pain, conjunctivitis, nausea, vomiting and diarrhea alone or in combination are indicators of underlying viral or bacterial infection. Specific ocular symptoms such as blurring, itching, burning, grating, or decreased visual acuity may be secondary to the iritis associated with JRA or ankylosing spondylitis. Chest pain may be due to pneumonia, the carditis of rheumatic fever, costochondritis or pericarditis. Melena and severe abdominal pain often accompany Henoch-Schonlein purpura. Dysphagia is a symptom of scleroderma, and diarrhea and weight loss of inflammatory bowel disease.

Renal abnormalities occur in lupus, and HSP and may be manifested by hematuria. Hematuria may also occur in children with hemoglobin AS and may be unrelated to joint symptoms. Neurologic symptoms are infrequently associated with arthritis and may indicate systemic lupus erythematosis or a vasculitis syndrome.

Allergic disorders do not always occur in children with a history of allergy, but a positive history might make that diagnosis more likely. 21% of the children with allergic reactions in our group reported previous allergic symptoms. Of the children with other causes of joint pain only 11% had positive histories for allergy.

Medications may have a role in causing articular complaints. Allergic drug reactions are not uncommon, and lupus-like syndromes have been related to a number of medications.

A psychologic history is not part of a routine evaluation of joint symptoms, but if a diagnosis of psychogenic pain is made it would be appropriate to try to identify possible sources of stress.

The second step in evaluating a child with joint pain is the physical examination. Children in this review who presented to the emergency room with joint symptoms limited to one joint and who had no systemic complaints frequently had physical examinations limited to that joint. This may be appropriate but several words of caution are necessary. A single joint should always be compared to the opposite side, not only to pick up subtle physical changes in the symptomatic joint, but also to recognize children with bilateral joint involvement. Secondly, evaluation of knee pain should always include examination of the ipsilateral hip.

A complete articular examination involves examining not only each joint of the body, including the neck, back, shoulders, and fingers, but also the muscles and skeletal surfaces. Bone tenderness may be present

in osteomyelitis, malignancies, trauma, scurvy and congenital syphilis. Tapping the distal end of a bone may cause local pain over an area of osteomyelitis. Enlargement of the bones may be due to infection, to callus formation following fractures, to bone cysts or tumors. Enlargement of the tibial tubercles occurs in Osgood-Schlatter's disease. Rickets may cause painless swelling of the epiphyses around the wrist and knee joints.

Each joint is examined for the presence of tenderness, heat, erythema, swelling, effusion and decreased range of motion. Joint tenderness is assessed with the joint at rest, with palpation, and with range of motion. At this point the somewhat semantic distinction between arthralgia and arthritis can be made. Arthralgia is defined as joint pain only. Arthritis represents the objective findings of joint inflammation: either joint swelling or any combination of heat, erythema and loss of motion. Hot, swollen joints may be seen in juvenile-rheumatoid arthritis, acute rheumatic fever, allergic reaction, Henoch-Schonlein purpura, septic arthritis and viral illness. Heat is less commonly a characteristic of orthopedic and traumatic disorders. Heat and swelling which is somewhat displaced from the joint may be indicative of osteomyelitis.

Children should be examined for the presence and character of a limp. Pseudoparalysis of a limb or limbs may be present in infants and young children with joint disease. Muscles should be examined for strength, tone, contractures and spasticity. Muscle wasting is a sign of a chronic process although wasting of the quadriceps mechanism may rapidly follow

injury or derangement of the knee. Severe muscle weakness is a finding in dermatomyositis, and muscle spasm may be the only objective sign of hip pathology.

The skin should be examined for the presence of rashes, edema, pigment changes, jaundice, ecchymoses, petechiae and subcutaneous nodules. Systemic onset juvenile rheumatoid arthritis, acute rheumatic fever, allergic reactions, Henoch-Schonlein purpura, lupus erythematosus, dermatomyositis, scleroderma, and many viral illnesses may be recognized by their characteristic skin changes. Testing for Raynaud's phenomenon may be carried out by placing the hands in a cold environment. The presence of Raynaud's phenomenon is suggestive of but not diagnostic for SLE, scleroderma, dermatomyositis or polyarteritis.

Complete physical examination should include careful palpation for lymphadenopathy. While enlarged cervical lymph nodes are frequently found in children with upper respiratory infections, generalized lymphadenopathy is suggestive of JRA or a malignant process. Enlargement of the liver and/or spleen may accompany viral infections as well as many of the rheumatic diseases, hematologic abnormalities and right heart failure.

Children who present with joint pain may have non-articular systemic illnesses. Two children in our group who presented with shoulder pain were found to have pneumonia. Meningitis may present with neck pain, otitis with temporomandibular joint pain, and appendicitis with hip pain. Physical examination is often the best tool for identifying these illnesses.

Once the initial history and physical examination are completed the physician must decide which, if any, laboratory tests might be helpful in establishing a diagnosis. In some cases no additional information is required. The child with tibial tubercle pain, swelling and tenderness may be sent home with the diagnosis of Osgood-Schlatter disease without a confirmatory x-ray. A child with mild joint pain, no objective joint tenderness or swelling and no systemic findings, who is otherwise well and active may also be sent home, although some physicians might choose to x-ray the affected joint. Similarly, a child with an influenza-like syndrome with myalgias and arthralgias might be discharged without laboratory studies.

Table 3-1 lists the more common causes of arthritis and arthralgia with the laboratory tests which may be most useful in their diagnosis. Complete blood count and erythrocyte sedimentation rate were the tests performed most frequently among the cases reviewed. While they provide no definite diagnoses, these determinations often divide children into useful categories. Children with normal hemoglobins, normal white blood counts and differentials, and normal erythrocyte sedimentation rates probably do not have serious acute rheumatic or infectious diseases. Erythrocyte sedimentation rates, in our group, were above 20 mm/hr in all children with juvenile rheumatoid arthritis, rheumatic fever, septic arthritis, osteomyelitis and septic arthritis.

X-rays are especially helpful in evaluating children suspected of having orthopedic or traumatic disorders. Radiographic examinations

Laboratory Tests Which May Be Of Diagnostic Value

Juvenile rheumatoid arthritis	CBC, ESR, ANA, RF, Eye exam
Acute rheumatic fever	CBC, ESR, Throat culture, ASO, AHT, Electrocardiagram, Chest x-ray
Allergic reactions	CBC, ESR (limited value), Serum Complement
Henoch-Schonlein purpura	CBC, ESR, Throat culture, ASO, AHT, stool guiaic, urinalysis
Dermatomyositis	ESR, CPK, SGOT, aldolase, stool guiaic, electromyogram, x-rays
Ankylosing spondylitis	ESR, x-rays of sacroiliac joints
Systemic lupus erythematosus	ANA, RF, LE prep, ESR, CBC with platelet count, urinalysis, DNA binding, Serum Complement
Scleroderma	ANA, RF, barium swallow x-ray
Polyarteritis syndromes	CBC, ESR, electrocardiogram, urinalysis
Septic arthritis	CBC, ESR, joint aspiration, bone scan, blood and synovial fluid cultures
Osteomyelitis	CBC, ESR, x-rays, bone scan, blood and bone cultures, Tine test or PPD
Cellulitis	CBC, ESR, bone scan, needle aspiration, blood cultures
Viral arthropathies	CBC, ESR, viral cultures and viral titers, Mycoplasma titers, serum complement, hepatitis associated antigen
Malignancies	CBC with platelet count, ESR, bone marrow aspiration, x-rays
Orthopedic disorders	X-rays, bone scan
Trauma	X-rays
Transient synovitis hip	CBC, ESR, x-rays (limited value)
Discitis	X-rays, bone scan, CBC, ESR

are most easily analyzed when both the symptomatic and corresponding normal joints are seen in comparison views. 74% of the children in our study with orthopedic disorders had x-rays which were diagnostic of their illnesses.

Antinuclear antibodies and rheumatoid factors are often assayed in children with joint symptoms. In our group, less than 5% of these tests performed were positive. Whether they should be omitted from the initial evaluation of a child with joint pain is debatable as long as there is some positive yield, but negative results should not be viewed as ruling out any disease except systemic lupus erythematosus.

Blood cultures were of significant value in identifying the causative organisms of septic arthritis and osteomyelitis. In several cases only one of three or four blood cultures from a single patient was positive, so when these diseases are suspected it is appropriate to take a number of samples.

Joint aspiration is an important tool for distinguishing inflammatory from infectious arthritis. Although children with JRA may have markedly elevated leukocyte counts in their synovial fluid and a predominence of polymorphonuclear cells,and children with septic arthritis may have normal or only moderately elevated cell counts, those with JRA will all have sterile cultures. The "classic" findings for joint fluid are shown in Appendix B, but deviations from the classic are common in children, especially those with JRA.

Bone scanning is a new tool which is useful in distinguishing cases of osteomyelitis, septic arthritis, cellulitis and bone infarction from

each other, and in identifying clinically unrecognized secondary sites of infection. The child is injected with a radiopharmaceutical and then an immediate (vascular phase) scan is taken over the symptomatic site. Two to four hours later a total body scan is run. In cases of osteomyelitis the initial post-injection scan shows increased uptake in the bone and in the overlying soft tissues. The delayed scan shows intense uptake focally in the bone at the site of infection with variable amounts of uptake in adjacent soft tissues and joints.

Children with septic arthritis show a pattern of increased uptake of the radiopharmaceutical on both sides of the joint without extension into bone on both early and delayed scans. While the early scans may be similar in children with cellulitis and septic arthritis, those with cellulitis usually have little or no increased uptake on the delayed scan. Children with cellulitis over a joint often have a pattern of uptake which does not conform exactly with the boundaries of the joint. In some cases the distinction between ce-lulitis and septic arthritis on bone scan will be obvious, but in others it will be subtle and more difficult to make.

Children with bone infarctions secondary to sickle cell anemia often have abnormal bone scans. The early vascular phase scans are normal, but late films show variable patterns of increased, decreased or spotty uptake over areas of bone pain (113).

Recently an association has been described between the histocompatibility antigen B27 (HLA-B27) and several of the diseases described in

this paper. While HLA-B27 is found in only 4-30% of controls, this antigen is present in about 90% of patients with ankylosing spondylitis, 76% with Reiter's disease and 55% with acute anterior uveitis (110). An increased prevalence of HLA-B27 has also been found in patients with reactive arthritis following Salmonella, Shigella or Yersinia infections (115). It is conceivable that in the future HLA typing may play a more predominant role in evaluating children with joint pain and/or swelling.

The fourth step in the evaluation on a child with joint complaints is follow-up. Despite careful history taking, physical examination and laboratory analysis many children will remain undiagnosed. Some will be treated empirically, because of the severity of symptoms, with antibiotics, corticosteroids, or skeletal traction, but the majority will receive aspirin or be told to rest. 20% of the children in our group received no therapy. Because so many of the diseases which cause joint symptoms in children are diagnosed primarily on the basis of clinical impression, follow-up becomes an integral part of evaluation. The course of illness may influence diagnosis. JRA is defined as a chronic illness, and usually is not diagnosed unless symptoms have been present for three to six months. Leukemia may not become apparent on bone marrow aspiration until weeks to months after joint symptoms appear. Viral arthropathies resolve spontaneously in days to weeks, and without resolution that diagnosis is called into question. Lyme arthritis was characterized by its tendency to recur, a finding which could only have been identified through follow-up.

Diagnosis is not only an intellectual exercise. Children with pauciarticular JRA need to be identified so that they may be followed with ophthalmologic examinations and chronic iritis treated if it occurs. The extra-articular manifestations of systemic lupus erythematosus or acute rheumatic fever cannot be treated unless the primary disorder is recognized.

Psychologic problems need follow-up as much as physiologic disorders. One child in our group had numerous emergency room visits for joint pains and each time was sent home with a diagnosis of unknown or psychogenic etiology. A later entry in the chart recorded a suicide attempt.

Summary

The charts of two hundred fifty children who presented to Yale New Haven Hospital from July, 1972 to June, 1976 with a chief complaint of joint pain and/or swelling were reviewed. 72% were assigned diagnoses and 28% had joint symptoms of unknown etiology. Septic arthritis was present in 7.6% of children, juvenile rheumatoid arthritis in 5.6%, osteomyelitis in 3.6% and acute rheumatic fever in 3.2% of those studied. Forty-nine different diagnoses were applied to the two hundred fifty cases.

Ages ranged from one month to eighteen years old. Juvenile rheumatoid arthritis, septic arthritis, transient synovitis of the hip and Henoch-Schonlein purpura were common among children under eight years old, while acute rheumatic fever, osteomyelitis, and orthopedic disorders were common in those eight years of age or older.

60% of the children were boys and 40% were girls. Allergic reactions were more common in females than males.

Pain was a chief complaint in over 80% of patients, but children with cellulitis or allergic reactions complained of joint swelling more often than joint pain.

Duration of symptoms ranged from one hour to several years. Children with orthopedic disorders and psycho-social problems often had complaints of long duration, while those with allergic reactions, cellulitis and Henoch-Schonlein purpura all had had symptoms for less than one week when they came to the hospital.

Trauma was reported in 24% of the cases studied, but in only 17% of these patients was trauma invoked as the direct etiology of joint symptoms. Trauma was reported frequently by patients with cellulitis, septic arthritis or osteomyelitis (50-70%). Antecedent illness was present in 30% of children and was most common in those with acute rheumatic fever, non-bacterial infections, Henoch-Schonlein purpura and allergic reactions.

Fever greater or equal to 38° centigrade was present in 36% of all patients; but was present in over 50% of those with juvenile rheumatoid arthritis, acute rheumatic fever, Henoch-Schonlein purpura and all types of infections. Fever was uncommon in those with orthopedic or traumatic disorders.

Rashes were often of diagnostic value and they were observed in 17% of children studied, including 100% of those with Henoch-Schonlein purpura, 86% of those with allergic reactions and 57% with juvenile rheumatoid arthritis (100% with systemic JRA).

The knees were the most common site of symptoms (53% of patients); and the ankles, hips, wrists, elbows, and shoulders were affected more frequently than the small joints of the hands and feet.

Joint examinations were negative in 18% of patients, revealed tenderness in 49%, pain with motion in 30%, swelling in 40%, effusion in 7%, heat in 22%, erythema in 12% and decreased range on motion in 19% of patients.

Laboratory tests were usually non-diagnostic. Anemia was found most frequently in children with juvenile rheumatoid arthritis or septic

arthritis. White blood counts had wide ranges of values in nearly every diagnostic category, but mean white counts were highest in children with juvenile rheumatoid arthritis and those with bacterial infections.

Erythrocyte sedimentation rates were elevated in many children, but were usually normal in those with transient synovitis of the hip, allergic, traumatic, and orthopedic disorders. X-rays were diagnostic in 74% of children with orthopedic disorders but were only positive in 34% of the one hundred sixty four total joint films taken.

Antinuclear antibodies, rheumatoid factors and positive lupus cell tests were found in only 1% of the study population.

Conclusions

Joint pain and/or swelling is a common complaint of children and may be the presenting manifestation of a large variety of illnesses. Although juvenile rheumatoid arthritis, acute rheumatic fever, osteomyelitis, septic arthritis and malignancies together only accounted for 20% of the diagnoses found in this review, they must be ruled out in any evaluation of a child with joint complaints.

Most laboratory tests used in the work-up of arthritis and arthralgia in childhood are not diagnostic, but erythrocyte sedimentation rates and x-rays may be most valuable. Skin rashes and the presence or absence of fever may also be helpful in determining the etiology of joint symptoms.

Although the cause of some complaints will always remain obscure, the most efficient approach to the child with arthritis or arthralgia requires a clear knowledge of the diagnostic possibilities, a careful medical history and physical examination, appropriate laboratory tests based on suspected diagnoses, and adequate follow-up.

APPENDIX A

Jones Criteria (Revised) for Guidance in the Diagnosis of Rheumatic Fever(29)

MAJOR MANIFESTATIONS

- Carditis
- Polyarthritis
- Chorea
- Erythema Marginatum
- Subcutaneous Nodules

MINOR MANIFESTATIONS

Clinical

- Previous rheumatic fever or rheumatic heart disease
- Arthralgia
- Fever

Laboratory

- Acute phase reactions
  - Erythrocyte Sedimentation Rate, C-reactive protein, leukocytosis
- Prolonged P-R interval

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plus

Supporting Evidence of Preceding Streptococcal Infection (Increased ASO or other streptococcal antibodies; positive throat culture for Group A streptococcus; recent scarlet fever)

The presence of two major criteria, or of one major and two minor criteria, indicates a high probability of the presence of rheumatic fever if supported by evidence of a preceding streptococcal infection. The absence of the latter should make the diagnosis doubtful, except in situations in which rheumatic fever is first discovered after a long latent period from the antecedent infection (e.g., Sydenham's chorea or low-grade carditis).

Appendix B - Examination of Joint Fluid (6)

Measure	Normal	Group I (Noninflammatory)	Group II (Inflammatory)	Group III (Septic)
Volume (ml) (knee)	<3.5	Often>3.5	Often>3.5	Often>3.5
Clarity	Transparent	Transparent	Translucent-opaque	Opaque
Viscosity	High	High	Low	Variable
WBC (per cu mm)	<200	200-2,000	2,000-100,000	>100,000*
Polymorphonuclear leukocytes (%)	<25%	<25%	50% or more	75% or more*
Culture	Negative	Negative	Negative	Often positive
Mucin clot	Firm	Firm	Friable	Friable
Glucose (mg/100ml)	Nearly equal to blood	Nearly equal to blood	>25, lower than blood	<25, much lower than blood

*Lower with infections caused by partially treated or by low virulence organisms.

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